Project Manual

for

WEST AGRICULTURAL SCIENCE FACITLITY

Tomball Independent School District

July 28, 2025 – Bid Set

Arcadis Inc. Project No.: ***202414***

Tomball ISD Proposal No.: ***987-25***

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Project Manual

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Date: July 28, 2025

Arcadis Inc. Project No.: 202414

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Tomball ISD Program Manager

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TABLE OF CONTENTS
WEST AGRICULTURAL SCIENCE FACITLITY
TOMBALL INDEPENDENT SCHOOL DISTRICT

I. PROPOSAL DOCUMENTS *Bid Set July 28, 2025*

Tomball Independent School District
Proposal #987-25 Issued 07/28/2025
Request for Competitive Sealed Proposals for the Construction of
Tomball Innovation Center & Related Site Work ..... *x*

AF	Subcontractor/Manufacturer Prequalification	1-5
AG	Affidavit of Non-Discriminatory Employment	1
AH	Indemnity and Hold Harmless Agreement	1
AI	Waiver, Release and Indemnity Agreement	1-2
AL	Certification of Project Compliance	1-2
AN	Proposal Phase Procedures	1-2

II. CONTRACT FORMS

BB	Performance Bond Form	1-2
BC	Payment Bond Form	1-2
CD	Right to Audit	1-2

III. SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

Section

01 10 00	Summary of Work	1-2
01 21 00	Allowances	1
01 22 00	Unit Prices	1-2
01 23 00	Alternates	1-2
01 25 00	Request for Substitution Procedures	1-5
01 26 00	Contract Administration Document Management	1-7
01 29 73	Schedule of Values	1-8
01 29 76	Progress Payment Procedures	1-4
01 31 00	Project Management Software	1-6
01 31 13	Project Coordination	1-5
01 31 19	Project Meetings	1-3
01 31 29	Notification of Architect Requirements	1-3
01 32 16	Construction Progress Schedule	1-8
01 32 23	Survey and Layout Data	1-2
01 33 00	Submittal Procedures	1-8
01 35 23	Tomball ISD Owner Site Rules	1-2
01 36 13	Cutting and Patching	1-5
01 42 13	Abbreviations and Acronyms	1-3

01 45 23 Testing and Inspection Services 1-7
01 45 23.13 Observation Procedures 1-3
01 50 00 Temporary Facilities and Controls 1-6
01 55 13.10 Stabilized Construction Entrance 1-4
01 55 26 Traffic Control 1-6
01 56 19 Tree Protection and Care 1-4
01 56 39 Temp Tree & Plant Protection 1-5
01 57 10 TPDES Requirements 1-4
01 57 19 Temporary Environmental Controls 1-8
01 57 23 Temporary Storm Water Pollution Control 1-10
01 74 16 Site Maintenance 1-4
01 74 19 Construction Waste Management and Disposal 1-2
01 77 00a Close-Out Procedures 1-14
01 77 00b AIA Affidavit Attachments 1-3
01 77 00c Txarcadis Affidavit Attachments 1-5
01 78 23 Operating and Maintenance Manuals 1-5
01 78 39 Project Record Documents 1-2

DIVISION 2 – EXISTING CONDITIONS

Section

02 32 00a Geotechnical Investigation 1-2
02 32 00b Geotechnical Report 1-44
02 41 00 Demolition 1-2
02 41 13.10 Removing Existing Pavement 1-2

DIVISION 3 - CONCRETE

Section

03 15 19 Below Slab Vapor Membrane 1-6
03 30 00 Cast-in-Place Concrete 1-13

DIVISION 4 - MASONRY

Section

04 20 00 Unit Masonry 1-14

DIVISION 5 - METALS

Section

05 21 00 Steel Joist Framing 1-4
05 31 00 Steel Decking 1-4
05 41 00 Structrual Metal Stud Framming 1-5
05 50 00 Metal Fabrications 1-6
05 52 13 Pipe and Tube Railing 1-4

DIVISION 6 - WOOD AND PLASTICS

Section

06 10 13 Rough & Finish Carpentry 1-6

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Section

07 21 00 Thermal Insulation 1-5
07 21 19 Foamed-In-Place Insulation 1-4
07 25 00 Weather Barrier 1-8
07 41 13 Metal Roof Panels 1-10
07 42 13 Metal Wall Panels 1-7
07 62 00 Sheet Metal Flashing – Pre Finished 1-11
07 65 26 Self-Adhering Sheet Flashing 1-5
07 92 00 Joint Sealants 1-5

DIVISION 8 - DOORS AND WINDOWS

Section

08 11 13 Hollow Metal Doors and Frames 1-7
08 31 13 Access Doors 1-4
08 33 13 Coiling Counter Doors 1-5
08 33 23 Overhead Coiling Doors 1-6
08 80 00 Glazing & Aluminum Frames 1-7
08 90 00 Louvers and Vents 1-4

DIVISION 9 - FINISHES

Section

09 21 13 Plaster Assemblies 1-7
09 21 16 Gypsum Board Assemblies 1-13
09 21 13 Ceramic Tiling 1-6
09 51 13 Acoustical Tile Ceilings 1-6
09 61 43 Concrete Floor Sealer 1-3
09 91 00 Painting and Re-Painting 1-9

DIVISION 10 - SPECIALTIES

Section

10 10 00 Miscellaneous Specialties 1-5
10 11 23 Tack Boards 1-3

10 14 00 Signage 1-6
10 14 53 Traffic Signage 1-4
10 44 00 Toilet, Bath and Laundry Accessories 1-6
10 44 13 Fire Extinguisher and Cabinets..... 1-3
10 56 26 Industrial Metal Shelving 1-3
10 73 26 Aluminium Walkway Coverings 1-5

DIVISION 11 - EQUIPMENT

Section

11 31 00 Residential Appliances 1-3
11 66 53.20 Athletic Sportsfield Netting 1-3
11 68 33.20 Soccer Field Equipment 1-2

DIVISION 12 - FURNISHINGS

Section

12 32 16 Manufactured Plastic-Laminate-Clad Casework..... 1-14

DIVISION 13 - SPECIAL CONSTRUCTION

Section

13 34 16.16 Aluminum Bleachers, Team Benches, and Press Boxes..... 1-5
13 34 19 Metal Building Systems 1-16

DIVISION 14 - CONVEYING SYSTEMS

NOT USED

DIVISION 21 – FIRE PROTECTION

NOT USED

DIVISION 22 - PLUMBING

Section

22 02 00 Basic Materials and Methods for Plumbing 1-18
22 02 01 Coordination Drawings 1-2
22 05 13 Comon Motor Requirements for Plumbing Equipment 1-5
22 05 16 Expansion Fittings and Loops for Plumbing Piping..... 1-4
22 05 29 Hangers and Support for Plumbing Piping and Equipment 1-7
22 05 48 Vibration and Seismic Controls for Plumbing Piping..... 1-4
22 05 53 Identification for Plumbing Piping and Equipment 1-4

22 07 16 Plumbing Equipment Insulation....1-3
22 07 19 Plumbing Piping Insulation....1-8
22 10 00 Plumbing Piping....1-23
22 11 19 Plumbing Specialties....1-9
22 30 00 Plumbing Equipment....1-7
22 40 00 Plumbing Fixtures....1-7

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

Section

23 02 00 Basic Materials and Methods for HVAC....1-18
23 05 13 Common Motor Requirements for HVAC Equipment....1-5
23 05 16 Expansion Fittings and Loops for HVAC Piping....1-4
23 05 29 Hangers and Supports for Piping and Equipment - HVAC....1-7
23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment....1-3
23 05 53 Identification for HVAC Piping and Equipment....1-3
23 05 93 Testing, Adjusting, And Balancing....1-6
23 07 13 Duct Insulation....1-10
23 07 19 HVAC Piping Insulation....1-8
23 08 00 Commissioning of HVAC Systems....1-8
23 09 63 Energy Management and Control System (EMCS)....1-26
23 21 13 Above Ground Hydronic Piping....1-8
23 23 00 Refrigerant Piping....1-4
23 31 13 Metal Ductwork....1-8
23 33 00 Ductwork Accessories....1-5
23 34 00 HVAC Fans....1-6
23 34 39 High-Volume, Low-Speed Propeller Fans....1-8
23 37 13 Air Distribution Devices....1-5
23 37 23 HVAC Gravitty Ventilators....1-4
23 41 00 Air Filters....1-2
23 62 13 Air Cooled Condensing Units....1-4
23 72 19 Energy Recovery Ventilator-Core Style....1-7
23 81 26 Split System Air-Conditioners....1-9
23 82 19 Fan Coil Unit....1-7

DIVISION 26 - ELECTRICAL

Section

26 02 00 Basic Materials and Methods for Electrical....1-18
26 02 01 Coordination Drawings....1-2
26 05 19 Wire, Cable and Related Materials....1-5
26 05 26 Grounding....1-3
26 05 33 Raceways....1-11
26 05 73 Short Circuit Coordination Study Arc Flash Hazard Analysis....1-7
26 06 34 Low Voltage Raceway System....1-2

26 08 00 Commissioning of Electrical Systems 1-8
26 09 13 Electrical Power Monitoring and Control 1-5
26 09 36 Lighting Controls (Stand-Alone) 1-9
26 21 13 Electrical Service Entrance 1-2
26 22 13 Low Voltage Distributions Transformers 1-3
26 22 22 Low Voltage Harmonic Mitigating Distribution Transformers ... 1-6
26 24 16 Panelboards 1-6
26 27 26 Wiring Devices 1-6
26 28 13 Fuses 1-2
26 28 16 Safety and Disconnect Switches 1-3
26 29 01 Motors and Starters 1-2
26 29 26 Miscellaneous Electrical Controls and Wiring 1-5
26 41 13.13 Lightning Protection System 1-3
26 43 13 Surge Protective Device(SPD) – Service Entrance 1-4
26 43 13.13 Surge Protective Devices(SPD) – Standard Interrupting 1-4
26 51 19 Lighting Fixtures - Light Emitting Diode (LED) 1-6
26 56 68 Exterior Athletic Lighting 1-7

DIVISION 27 – COMMUNICATIONS

Section

27 02 00 Basic Materials and Methods for Communications Systems . 1-29
27 05 26 Grounding and Bonding for Communications Systems 1-7
27 05 28 Pathways for Communications Systems 1-8
27 05 43 Underground Ducts and Raceways for Communications Systems 1-7
27 11 00 Communications Room Fittings 1-5
27 15 00 Communications Horizontal Cabling 1-13
27 41 16 Integrated Audio-Video System and Equipment 1-16
27 51 29 Emergency Radio Communication Enhancement System 1-7

DIVISION 28 – SAFETY AND SECURITY

Section

28 02 00 Basic Materials and Methods for Safety and Security Systems 1-31
28 05 00 Basic Materials and Methods for Fire Alarm 1-16
28 10 00 Access Control System 1-8
28 46 00 Fire Alarm System with Electronic Audio and Visual Devices 1-16

DIVISION 31 - EARTHWORK

Section

31 00 00 Earthwork 1-6
31 06 20.15 Cement Stabilized Sand 1-6
31 06 20.17 Utility Backfill Materials 1-8
31 11 00 Clearing and Grubbing 1-2
31 20 00 Earth Moving 1-6
31 22 00 Grading 1-4
31 22 19 Finish Grading 1-3
31 23 16.14 Trench Safety System 1-4
31 23 33 Trenching and Backfilling 1-14
31 32 13.19 Soil Stabilization 1-4

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section

32 11 13.13 Lime-Treated Subgrades 1-6
32 13 13 Concrete Paving and Flatwork 1-7
32 13 13.10 Concrete Pavement Curing 1-4
32 13 13.25 Concrete Sidewalks 1-4
32 13 73 Concrete Paving Joint Sealants 1-4
32 16 13 Curbs and Gutters 1-4
32 17 23 Pavement Markings 1-2
32 17 23.26 Natural Field Sport Surfacing 1-2
32 17 23.27 Natural Field Installation 1-4
32 17 23.28 Natural Field Root Zone 1-4
32 31 13 Chain Link Fences and Gates 1-5
32 31 26 Traffic Gates and Operators 1-4
32 84 23 Undergrounb Sprinklers 1-11
32 91 13.13 Topsoil Placement and Grading 1-2
32 92 13 Hydro-Mulching 1-4
32 92 23 Sodding 1-4
32 93 00 Landscaping 1-6

DIVISION 33 – UTILITIES

Section

33 05 13 Manholes and Structures 1-10
33 05 13.13 Manhole Grade Adjustment 1-2
33 05 16.13 Precast Concrete Utility Structures 1-4
33 05 16.16 Concrete for Utility Construction 1-14
33 06 10.14 Polyvinyl Chloride (PVC) Pipe 1-6
33 06 10.15 Ductile Iron Pipe and Fittings 1-6
33 06 40.10 HDPE Solid and Profile Wall Pipe 1-6
33 06 40.11 Reinforced Concrete Pipe 1-2
33 11 00 Water Utility Distribution Piping 1-14

33 12 13.10 Tapping Sleeves and Valves 1-4
33 12 13.12 Wet Connections 1-2
33 12 16 Water Utility Distribution Valves 1-4
33 12 19 Water Utility Distribution Fire Hydrants 1-4
33 12 40 Valve Boxes, Meter Boxes, and Meter Vaults 1-6
33 13 00 Disinfecting of Water Utility Distribution 1-4
33 13 00.10 Hydrostatic Testing of Pipelines 1-2
33 31 00 Sanitary Utility Sewerage Piping 1-6
33 31 00.10 Acceptance Testing for Sanitary Sewers 1-10
33 41 00 Storm Utility Drainage Piping 1-4
33 49 13 Storm Drainage Manholes, Frames, and Covers 1-4

IV. INDEX OF DRAWINGS

SHEET NO. SHEET NAME

G0.00	COVER SHEET
G1.00	GENERAL/CODE INFORMATION
G1.01A	CODE ANALYSIS
G1.01B	HC CODE REVIEW MAIN BUILDING
G1.01C	HC CODE REVIEW POULTRY BLDG.
G1.01D	HC CODE REVIEW FIELD HOUSE
G1.01E	HC CODE REVIEW PRESS BOX
G1.02	1ST FLOOR LIFE SAFETY PLAN
CA1.00	COMPOSITE SITE PLAN
CA1.01	SITE PLAN AREA 'S1'
CA1.02	SITE PLAN AREA 'S2'
CA1.03	ENLARGED SITE PLAN - FIELD HOUSE
CA1.04	ENLARGED SITE PLAN - PRESSBOX
CA1.05	SITE DETAILS
CA1.06	GATE DETAILS & SCHEDULE
L1.01	LANDSCAPE PLAN AREA 'S1'
L1.02	LANDSCAPE PLAN AREA 'S2'
C0.00	CIVIL COVER SHEET
C0.01	GENERAL NOTES
C0.02	HARRIS COUNTY ENGINEERING REVIEW SHEET
C0.03	HARRIS COUNTY FLOOD CONTROL REVIEW SHEET
C0.04	TOPOGRAPHIC SURVEY
C1.00	OVERALL LAYOUT
C1.01	DEMOLITION PLAN (SHEET 1 OF 2)
C1.02	DEMOLITION PLAN (SHEET 2 OF 2)
C1.03	SITE LAYOUT (SHEET 1 OF 2)
C1.04	SITE LAYOUT (SHEET 2 OF 2)
C1.05	FIRE LANE LAYOUT
C1.06	LEFT TURN LANE
C2.01	GRADING LAYOUT (SHEET 1 OF 2)
C2.02	GRADING LAYOUT (SHEET 2 OF 2)
C3.01	STORM SEWER LAYOUT (SHEET 1 OF 2)
C3.02	STORM SEWER LAYOUT (SHEET 2 OF 2)
C3.03	STORM WATER POLLUTION PREVENTION PLAN (SHEET 1 OF 2)
C3.04	STORM WATER POLLUTION PREVENTION PLAN (SHEET 2 OF 2)

C3.05 DRAINAGE AREA MAP (SHEET 1 OF 2)
C3.06 DRAINAGE AREA MAP (SHEET 2 OF 2)
C3.07 STORM SEWER CALCULATIONS
C4.01 WATER LINE & SANITARY SEWER LAYOUT (SHEET 1 OF 2)
C4.02 WATER LINE & SANITARY SEWER LAYOUT (SHEET 2 OF 2)
C5.01 JOINT LAYOUT PLAN (SHEET 1 OF 2)
C5.02 JOINT LAYOUT PLAN (SHEET 2 OF 2)
C7.01 PAVING DETAILS
C7.02 STORM SEWER DETAILS
C7.03 WATER & SANITARY SEWER DETAILS
C7.04 STORM WATER POLLUTION PREVENTION DETAILS
C7.05 GRASS FIELD DETAILS
C7.06 HARRIS COUNTY SWP DETAIL
C7.07 HARRIS COUNTY CONCRETE PAVEMENT DETAIL 1
C7.08 HARRIS COUNTY CONCRETE PAVEMENT DETAIL 2
C7.09 HARRIS COUNTY PAVEMENT MARKING DETAIL 1
C7.10 HARRIS COUNTY PAVEMENT MARKING DETAIL 2
C7.11 HARRIS COUNTY TRAFFIC CONTROL DETAIL

LI1.1 IRRIGATION PLAN (SHEET 1 OF 2)
LI1.2 IRRIGATION PLAN (SHEET 2 OF 2)

S0.00 GENERAL NOTES
S0.01 GENERAL NOTES
S0.02 GENERAL NOTES
S0.03 TYPICAL FOUNDATION DETAILS
S0.04 TYPICAL FRAMING DETAILS
S1.00 COMPOSITE FOUNDATION PLAN
S1.01 AREA 'A' FOUNDATION PLAN
S1.02 AREA 'B' FOUNDATION PLAN
S2.01 FOUNDATION DETAILS
S2.02 FOUNDATION DETAILS

A1.01 1ST FLOOR COMPOSITE PLAN
A2.01 AREA 'A1' 1ST FLOOR PLAN
A2.02 AREA 'B1' 1ST FLOOR PLAN
A2.03 SCHEDULES AND OPENINGS
A3.01 PLAN DETAILS
A4.01 ROOF PLAN
A4.02 CANOPY PLAN AND DETAILS
A5.01 ENLARGED RESTROOM PLANS
A6.01 PARTITION TYPES AND WALL DETAILS
A6.02 WALL SECTIONS
A6.03 WALL SECTIONS
A7.01 EXTERIOR ELEVATIONS

A7.02 INTERIOR ELEVATIONS
A9.01 FRAME ELEVATIONS AND OPENING DETAILS
A10.01 AREA 'A1' 1ST FLOOR RCP
A10.02 AREA 'B1' 1ST FLOOR RCP
A11.00 INTERIOR FINISH LEGEND
A11.01 AREA 'A1' 1ST FLOOR FINISH PLAN
A12.00 SIGNAGE DETAILS
A12.01 SIGNAGE PLAN AND DETAILS

M0.01 MECHANICAL SYMBOL LEGEND
M0.11 MECHANICAL GENERAL NOTES
M2.11 MECHANICAL PLAN LEVEL 1
M5.01 MECHANICAL SCHEDULES
M6.01 MECHANICAL DETAILS
M7.01 MECHANICAL CONTROL DIAGRAMS

E0.01 ELECTRICAL SYMBOL LEGEND
E0.11 ELECTRICAL GENERAL NOTES
E1.01 ELECTRICAL SITE PLAN
E1.11 ELECTRICAL LIGHTING PLAN LEVEL 1
E2.11 ELECTRICAL POWER PLAN LEVEL 1
E5.01 ELECTRICAL SCHEDULES
E5.02 ELECTRICAL SCHEDULES
E6.01 ELECTRICAL DETAILS
E6.02 ELECTRICAL DETAILS

P0.01 PLUMBING SYMBOL LEGEND
P0.11 PLUMBING GENERAL NOTES
P2.11 PLUMBING PLAN LEVEL 1
P4.01 PLUMBING RISER DIAGRAM
P4.02 PLUMBING RISER DIAGRAM
P5.01 PLUMBING SCHEDULES
P6.01 PLUMBING DETAILS

T0.01 TECHNOLOGY SYMBOL LEGEND
T0.21 TECHNOLOGY SITE PLAN
T2.11 TECHNOLOGY PLAN LEVEL 1
T3.01 TECHNOLOGY ENLARGEMENTS
T6.01 TECHNOLOGY DETAILS
T6.02 TECHNOLOGY DETAILS
T6.03 SECURITY DETAILS

SECTION AF

SUBCONTRACTOR / MANUFACTURER PREQUALIFICATION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements including Section 01 25 00 – Request for Substitution Procedures.

B. The Contract Documents – Drawings and Specifications – are produced and based on specific manufacturer's materials and assemblies, including proper interface with adjacent materials and assemblies. The 'basis of design' manufacturer and product is identified in each Section of Specifications or as noted on the Drawings.
   01 Unless specifically defined as 'proprietary' or 'no substitutions', other acceptable manufacturers are listed in the Specification Section.
   02 These manufacturers have previously demonstrated a superior level of product and service and are therefore listed as 'Acceptable' Manufacturers.

C. In addition to a specific manufacturer's material / product used as the Basis of Design, certain Sections of the Specifications list Acceptable Subcontractors. These Sub-contractors have previously demonstrated a superior level of workmanship, capability, and service.

D. It is not the intent to limit competition or exclude other qualified manufacturers or sub-contractors from proposing on the Work; however, those requesting to be added to an 'acceptable' list are required to provide documentation for evaluation by the Architect or Consultant prior to submitting a bid / proposal to a General Contractor.

PART 2 - MANUFACTURERS

2.1 ACCEPTABLE MANUFACTURER LISTINGS

A. The materials, products and equipment described in the Proposal Documents establish a standard of required function, properties, dimension, appearance and quality to be met by any proposed substitution.
   01 The manufacturer, products and equipment named as the Basis of Design, and the procedures covered by these Specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance.

B. In Sections where a particular manufacturer's product is used as the "Basis for Design", that product and other specified descriptions shall establish the minimum requirements, performance criteria and attributes necessary to meet the Contract Document requirements.

01 Where manufacturer and or product are specified as “no substitutions”, only the specified manufacturer and product shall be acceptable to include in a Proposal.

C. In Sections that have additional acceptable manufacturers listed, those manufacturers have been included based on historical data of providing quality products and assemblies.

D. It is entirely incumbent on the other listed acceptable manufacturers to propose on and provide products, materials, equipment and / or assembly(s) which fully meet or exceed the ‘Basis of Design’ product, attributes, performance, and all other specified requirements.

01 By submitting a proposal / bid to a General Contractor, a listed acceptable manufacturer is affirming that their proposal / bid meets or exceeds the ‘Basis of Design’ material / product / assembly and all specified requirements.

E. The lists are not all inclusive nor is there any warranty, express or implied, on the part of the Owner, Architect, or his Consultants that the Subcontractors and / or manufacturers listed shall perform satisfactorily on this Project, nor that they are financially sound at the present time. Since it is required that the Contractor shall have the Contractor-Subcontractor relationship required by the Contract Documents with his Subcontractors, it is imperative that he be satisfied with the ability and financial strength of the listed Subcontractors.

2.2 PROCEDURES DURING BIDDING / PROPOSAL PERIOD

A. The acceptable manufacturers lists are not all inclusive; and such lists are not intended to restrict competition or exclude otherwise qualified manufacturers from submitting bids. Accordingly, Proposers may submit for consideration the names and qualifications of other manufacturers / providers which they feel are qualified by following the procedure enumerated below.

B. Each manufacturer / provider requesting to be added to the acceptable list of manufacturers included in individual Specification Sections must submit the following qualification information a minimum of ten (10) days prior to the proposal date.

01 Submit information to the Architect and relative A/E Consultant as applicable.
02 Submissions shall be accepted only in electronically in PDF format.
03 Faxed or telephonic submissions shall not be accepted.

C. For a manufacturer’s product to be considered for acceptance, the following material must be submitted to the Architect or relative Consultant, as applicable, not later than ten (10) calendar days prior to the date set for the receipt of proposals from General Contractors:

01 Name of manufacturer, contact person, phone number and email address.
02 Provide the Specification Section number(s) and the specific specified product for which the substitution request is being made.
03 Submit a copy of the printed project Specification Section with each and every paragraph and statement initialed by the submitter that their proposed product shall meet or exceed the specified properties, attributes and / or performance criteria. Where proposed products may

deviate from the Specification, clearly indicate so; and submit / describe in detail what alternatively is proposed to be accepted.

04 Provide complete and specific product data for the proposed product, including but not limited to like information, performance criteria, test results, etc. established for the "Basis of Design" product and accompanying Specifications. Submission of general documentation that does not specifically identify only the proposed substitution shall not be accepted.

05 If the proposed product alters an assembly, detail or interface with adjacent materials as described in the Contract Documents, provide graphic illustration of the revised assembly, detail or interface with adjacent materials. Submission of general or generic documentation / details that do not specifically relate to this project shall not be accepted.

06 Other supporting documentation the submitter wants to be included in the evaluation process.

D. Submissions which fail to clearly delineate the specific information to be considered shall not be considered for acceptance; nor will the submitter be notified to correct the deficiency of the submitted material.

E. A submitted product found to be acceptable for use in this Project shall be included by Addendum. No other form of approval shall allow the product to be substituted.

F. Proposers shall include in their proposal only manufacturers that are listed as the Basis of Design or listed as an acceptable manufacturer in the Specifications, or subsequently included in an Addendum as being acceptable.

PART 3 - SUBCONTRACTORS

3.1 ACCEPTABLE SUBCONTRACTOR LISTINGS

A. Certain Sections of the Specifications may list Acceptable Subcontractors. For the Work included in those Sections, Proposals must include one of the Sub-Contractors listed. Where a Specification Section does not include a list of Acceptable Subcontractors, the General Contractor / Proposer is free to utilize any Subcontractor that the General Contractor feels is an acceptable Subcontractor.

B. The Subcontractors listed as acceptable have been selected because of a demonstrated ability to acceptably perform the Work required for a project of this type and size within the allowable time anticipated for construction. It is not intended to preclude the use of other equally or better qualified Subcontractors provided that same meet the requirements of this particular project.

C. The lists are not all inclusive nor is there any warranty, express or implied, on the part of the Owner, Architect, or his Consultants that the Subcontractors and / or manufacturers listed shall perform satisfactorily on this Project nor that are they financially sound at the present time. Since it is required that the Contractor shall have the Contractor-Subcontractor relationship required by the Contract Documents with his Subcontractors, it is imperative that he be satisfied with the ability and financial strength of the listed Subcontractors.

3.2 PROCEDURES DURING BIDDING / PROPOSAL PERIOD

A. Any Proposer desiring to have a Subcontractor included in the list of Acceptable Subcontractors shall have the Subcontractor submit qualification information to the Architect or pertinent Consultant as applicable for evaluation to be accepted to provide work on this project.

B. Each manufacturer requesting to be added to the acceptable list of manufacturers included in individual Specification Sections must submit the following qualification information a minimum of ten (10) days prior to the proposal date.

01 Submit information to the Architect and relative A/E Consultant as applicable.

02 Submissions shall be accepted only in hard copy or electronically in PDF format.

03 Faxed or telephonic submissions shall not be accepted.

C. For a proposed Subcontractor to be considered for acceptance the following material must be submitted to the Architect or relative Consultant, as applicable, not later than ten (10) calendar days prior to the date and time set for the receipt of proposals from general contractors:

01 Name of Subcontractor, contact person, phone number and email address.

02 Provide the Specification Section number(s) and the specific trade(s) for which the substitution request is made for.

03 Submit a copy of the printed project Specification Section with each and every paragraph and statement initialed by the submitter that their proposed product shall meet or exceed the specified properties, attributes and / or performance criteria. Where proposed products may deviate from the Specification, clearly indicate so; and submit / describe in detail what alternatively is proposed to be accepted.

04 Provide a completed Qualification Statement (AIA Document A305).

05 A list of at least five (5) projects of <u>similar scope</u> as the project being proposed on, which have been completed in the last five (5) years. Submitted information for each project shall include the following information:

a. Project name and location.

b. General Contractor’s project manager name and contact information (current phone number and email address)

c. Architect’s project manager name and contact information (current phone no. and email address).

06 A list of at least three (3) references of General Contractors and three (3) Architects which the proposer has completed work for in the last five (5) years including contact information (current phone number and email address).

07 Other supporting information the proposed Subcontractor wants to be considered in the evaluation process.

D. A Subcontractor found to be acceptable for use on this project shall be included by Addendum. No other form of approval shall allow the Subcontractor to be substituted.

E. Proposers shall include in their proposal only Subcontractors that are listed as acceptable in the Specifications, or subsequently included in an Addendum as being acceptable.

END OF SECTION

SECTION AG

AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

STATE OF _____)
)
COUNTY OF _____)

_____being duly sworn, deposes and says that he/she is
(name)

_____of_____
(title) (company)

the party that made the foregoing Proposal; that such party as Proposer does not and shall not discriminate against any employee or Proposer for employment because of race, religion, color, sex or national origin. If awarded the Proposal and Contract under this Proposal, said party shall take affirmative action to ensure that Proposers are employed and that employees are treated, during employment, without regard to their race, religion, color, sex or national origin. If successful as the Proposer under the foregoing Proposal this party shall post non-discrimination notices in conspicuous places available to employees and Proposers for employment setting forth the provision of this affidavit.

Furthermore, said party agrees to abide by the assurances prescribed in all Federal and State related statutes with the Owner if selected as the successful Proposer by the Owner.

_____
Company Name

_____
Signature

_____
Title

STATE OF _____)
)
COUNTY OF _____)

SWORN TO AND SUBSCRIBED before me at _____, Texas, this the _____ day

of _____, 20 _____, A.D.

_____

Notary Public in and for _____ County, Texas

END OF SECTION

SECTION AH

INDEMNITY AND HOLD HARMLESS AGREEMENT

STATE OF _____)
)
COUNTY OF _____)

This Agreement is made by and between Tomball Independent School District (called "Owner")

and _____ (called "Contractor"),
(company)
to be effective from its date of execution, in which Contractor, as condition precedent to its engagement to perform, supervise, and subcontract particular work on behalf of Owner referred to for all purposes as the *TOMBALL WEST AGRICULTURAL SCIENCE FACILITY* (called "Project") agrees to indemnify and hold harmless Owner, its Board of Trustees, individually and in their capacities, and all employees and agents of Owner, from any and all claims, actions, demands, suits, causes or otherwise, for personal injury, death or property damage, arising out of or related directly or indirectly to the Project, brought by or on behalf of any person, group of persons, or legal entity.

All Contracts and other documents relating to the Project are hereby incorporated herein and deemed to be a part hereof by reference. Further, Contractor agrees that the consideration which it is to receive for the performance of work under Project be deemed adequate consideration for the execution of this indemnity and hold harmless agreement, of which it forms an integral part.

Executed in duplicated originals this ____day of _____, 20_____.

By:
_____
Its Authorized Representative

_____
CONTRACTOR

TOMBALL INDEPENDENT SCHOOL DISTRICT

By:
_____
Its Authorized Representative
OWNER

END OF SECTION

SECTION AI

WAIVER, RELEASE AND INDEMNITY AGREEMENT

Whereas, the following entities:

Arcadis Inc., hereinafter called "Architect"	Architectural
Talon Engineering, hereinafter called "Consultant"	Civil
DBR, Inc, hereinafter called "Consultant"	MEP
CJG Engineers, hereinafter called "Consultant"	Structural

have utilized certain electronic AutoCAD and / or Revit model files in preparation of drawings for the Project, *TOMBALL WEST AGRICULTURAL SCIENCE FACILITY*, on behalf of Tomball Independent School District, the "Owner", and

Whereas, _____, a Subcontractor/Contractor for _____ or _____, a subtier contractor to _____ hereafter "Subcontractors" desires to obtain copies on magnetic disk of certain of the Architects and / or Consultant's computer aided drafting (AutoCAD) files Revit model(s) consisting of construction drawings for the Project, hereinafter, "Electronic Media," and

Whereas, Architect and / or Consultant is willing to provide copies for the convenience of Subcontractors only under certain express conditions of understanding, acknowledgment and covenant as hereinafter provided without qualification.

Now therefore, Architect and Subcontractor agree as follows:

1. ACKNOWLEDGEMENT AND LIMITATIONS: It is acknowledged that (1) Architect's and / or Consultant's instruments of professional serves are the hard copy Drawings and Specifications issued by Architect hereinafter "Instrument", (2) the Electronic Media are not substitutions for said Instruments, (3) differences may exist between said Instruments and the Electronic Media which Architect and / or Consultant is under no obligation to discover or disclose if known, (4) the Electronic Media may be incompatible with the Subcontractor's software and hardware configurations. In all ways, including those enumerated, Subcontractors accept the Electronic Media "as is" and Architect and / or Consultant is under no obligation to correct, update for changes, enhance or maintain the Electronic Media for Subcontractors. Architect does not represent or warrant that the Electronic Media are complete, free from defects, or accurate now or in the future. It is acknowledged, finally, that no client relationship is created by or through this instrument between Architect and / or Consultant and Subcontractors.

2. WAIVER AND RELEASE: Subcontractors agree all risk of incomplete, inaccurate, defective and variant information contained in the Electronic Media, and waives, quits, and forever discharges and releases the Owner, the Architect and / or Consultant and there officers, directors, employees and successors for every claim arising out of or related to any error, discrepancy, inaccuracy, variation or other defect in the Electronic Media, whether or not resulting in whole or in part from an act, error or omission of the Architect and / or Consultant and whether or not such claim is known or unknown as of the date of this waiver and release.

3. REUSE: The Electronic Media is not reusable for any other project or for additions or extensions of the project identified in the Electronic Media. Architect and / or Consultant does not authorize release of the Electronic Media to any person or party other than the Subcontractors, and the Subcontractors agree and covenant not to release the Electronic Media to any other party.

4. INDEMNIFICATION: Use of the Electronic Media shall be at the sole risk of the Subcontractors and without liability or legal expense to the Owner or the Architect and / or Consultant; further, Subcontractors shall, to the fullest extent permitted by law, defend, indemnify and hold the Owner, the Architect and / or Consultant and its officers, directors, employees and successors harmless from all claims, damages, including bodily injury or death, losses and expenses, including attorney fees, arising out of or resulting in whole or in part from the use of the Electronic Media.

5. DISPUTES: Due to the risk of damage, anomalies in transcription or copying and modification during use by Subcontractors where intended or otherwise, it is agreed the Architect and / or Consultant's archived copy of the Electronic Media, if Architect and / or Consultant chooses to maintain same shall be conclusive, un-rebuttable proof in all disputes over the content of the Electronic Media furnished to Subcontractors by this Agreement.

Wherefore, the parties have signed this Release, Waiver and Indemnify Agreement on the

_____ Day of _____, 20_____.

ARCHITECT:

ARCADIS INC.

By: _____

Title: _____

Date: _____

CONSULTANT:

_____

By: _____

Title: _____

Date: _____

CONTRACTOR:

_____

By: _____

Title: _____

Date: _____

SUBCONTRACTOR:

_____

By: _____

Title: _____

Date: _____

END OF SECTION

FORM AL

CERTIFICATION OF PROJECT COMPLIANCE

Distribution to:

District	☐	**Architect/Engineer**	☐
Contractor	☐	**Texas Education Agency**	☐
Other	☐	**Building Department**	☐

1. PROJECT INFORMATION:
West Agricultural Science Facility
Berry Point Drive
Cypress, Texas 77433

ARCHITECT/ENGINEER:
Arcadis Inc.
1330 Post Oak Blvd., Ste 2250
Houston, Texas 77056

CONTRACTOR/CM:

PROJECT NUMBER: 202414

CONTRACT DATE:

DISTRICT: Tomball Independent School District
310 S. Cherry Street
Tomball, Texas 77375

DATE DISTRICT AUTHORIZES PROJECT:

BRIEF DESCRIPTION OF PROJECT:

New agricultural science facility

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 enrollment projections, educational specifications and objectives of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: Tomball I.S.D. **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 State Board of Education, July 1992, and as provided by the district.

ARCHITECT/ENGINEER: Arcadis Inc. **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:**

5. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: Tomball I.S.D. **BY:** **DATE:**

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:

– name and address of the school facility
– the Architect/Engineer and Contractor
– the school district's project number (if applicable)
– the date of execution of the construction contract
– name, address, and telephone number of the school district
– 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 §61.104, 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.

END OF FORM

SECTION AN

PROPOSAL PHASE PROCEDURES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 This Section contains procedures to be followed by General Contractor Proposers and Subcontractors / Material Suppliers during the proposal phase of the Project.

C. Related Work:
   01 All Sections of Specifications contained in the Project Manual.
   02 All Drawings issued as Contract Documents.
   03 All Addenda issued during the proposal phase.

1.2 SUBMITTALS

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements.

1.3 QUALITY ASSURANCE

A. The Proposer's Qualification Statement, including accompanying documents, is the primary tool used in the Competitive Sealed Proposal evaluation process. It is the Proposer's opportunity to demonstrate their strengths and qualifications.

B. It is the Proposer's sole responsibility to provide complete information on all required qualification documents.

C. It is the Proposer's sole responsibility to provide Qualification Statement, including accompanying documents in a timely manner to allow ample time to allow for reference inquiries and responses, and other evaluation processes.
   01 No attempt shall be made by the Architect to expedite responses from references submitted by the Proposer.
   02 Non-responses from Proposer's references shall have a negative impact on the Proposer in the evaluation process.

D. It is the Proposer's sole responsibility to provide reference information that is current, accurate and viable.
   01 Proposers are highly encouraged to contact their submitted references, advise them they will be receiving a reference form, and to return it promptly to the Architect.
   02 Evaluation reference requests shall be distributed to Proposer's submitted references by email.
   03 No attempt shall be made by the Architect to correct inaccurate information submitted by the Proposer.

04 No attempt shall be made by the Architect to contact Proposer or reference recipients for failure to return a response in a timely manner.

1.4 ON-LINE ACCESS TO PROJECT INFORMATION

A. The RFP and all documents in total can be downloaded from the Tomball ISD Purchasing website: https://www.tomballisd.net/about-tisd/departments/finance/purchasing/bids-and-proposals.

01 If you have trouble with the link, go to the Tomball ISD website and at the "Find" bar type *bids*. This will take you directly to the procurement page.

02 Contact the Program Manager if you encounter a problem: Lockwood, Andrews & Newnam, Inc (713) 266-6900.

PART 2 – PROCEDURES

2.1 PROPOSAL PHASE REQUEST FOR INFORMATION

A. All requests for information during the Proposal Phase should be made in writing by email.

B. Requests for information should be made directly to Arcadis Inc. noting the responsible party / consultant:

01 Architectural / General: Arcadis Inc: Blake Norris
Email: blake.norris@arcadis.com

02 Civil: Talon Engineering: Brian Reed
Email: brian@taloncivil.com

03 MEP: DBR, Inc: Steve Sanchez
Email: ssanchez@dbrinc.com

04 Structural: CJG Engineers: Hunter Kornegay
Email: hkornegay@cjgengineers.com

C. All Proposal RFI's shall be responded to in writing by return email only to the original sender.

D. Official changes to the Contract Documents originating from proposal RFI's shall be issued by Addendum to all plan holders.

2.2 ADDENDA

A. As much as practical, all Addenda shall be issued by the architect.

B. All Addenda shall be issued electronically to all plan rooms and plan holders registered with the Architect.

01 All Addenda will be posted to the Owners' website for proposers' viewing.

02 All Addenda will be posted to the architects' website for proposers' viewing.

END OF SECTION

SECTION BB

PERFORMANCE BOND FORM

STATE OF _____)
)
COUNTY OF _____)

KNOW ALL MEN BY THESE PRESENT, that we, _____, a Corporation of the State of _____, with home office and principal place of business in _____, _____, hereinafter called "Principal" and _____, a Corporation of the State of _____, hereinafter called "Surety" are held and firmly bond unto the Tomball Independent School District, hereinafter called "Owner", in the amount of _____ ($_____) Dollars for payment whereof the said principal and surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

The condition of this obligation is such that whereas the Principal has entered into a certain Contract with the Tomball Independent School District, the Owner, dated the _____ day of _____, 20_____, for the complete construction on the property of the Owner, located in Harris County, Texas, of the Work described as:

TOMBALL WEST AGRICULTURAL SCIENCE FACILITY
FOR
TOMBALL INDEPENDENT SCHOOL DISTRICT

which said Contract and Documents referred to therein is herein now referred to and made a part hereof as fully and completely as if copies in detail herein.

NOW, THEREFORE, the condition of this obligation is such that if said Principal shall well and truly and faithfully perform all the undertakings, covenants, terms, conditions, and agreements of said Contract, including, but not limited to, the faithful performance of the Work required in accordance with the Plans and Specifications, during the original term thereof and extension thereof which may be granted by the Owner with or without notice to the Surety, and if said Principal shall satisfy all claims and demands incurred under such Contract and shall fully indemnify and save harmless the Owner from all costs, damages and reasonable expenses which it may suffer by reason of failure so to do and shall fully reimburse and repay the Owner all outlay and expenses, including attorney's fees, which the Owner may incur in making good any default, and shall reimburse and repay the Owner for all costs, including attorney's fees, which the Owner may incur in the prosecution or defense of any suit or proceeding arising out of the breach or default of the Principal, then this obligation shall be void; otherwise, to remain in full force and effect.

The said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder or of the Specifications accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of such change, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the Specifications thereunder.

It is expressly provided that if any legal action shall be filed upon this bond, venue shall lie in Harris County, Texas.

Simultaneously with the execution of this Performance Bond, the parties hereto have executed a Payment Bond, reference to which is made for all purposes. Nothing in this Performance Bond shall in any way invalidate or nullify the obligations of the parties as set forth in said Payment Bond.

Provided, however, that this bond is executed pursuant to the provisions of Texas Government Code Chapter 2253, and liabilities on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copies at length herein.

Provided, however, that nothing in the bond shall be construed to limit the rights of the beneficiaries of this Bond which they might have under general, special or the common law of the State of Texas not inconsistent with the terms hereof and not inconsistent with the provisions of Texas Government Code Chapter 2253, as amended.

IN TESTIMONY WHEREOF, the parties hereto have executed this instrument on this _____ day of _____, 20 _____.

_____
(Authorized Signature of Principal)

_____
(Title)

APPROVED AS TO FORM:

_____
Owner: Tomball Independent School District

_____
Attorney Representing Owner

_____
(Title)

ATTEST:

_____
(Secretary of Principal's Corporation)

_____
(Authorized Signature of Surety)

END OF SECTION

SECTION BC

PAYMENT BOND FORM

STATE OF _____)
)
COUNTY OF _____)

KNOW ALL MEN BY THESE PRESENT, that we, _____, a Corporation of the State of _____, with home office and principal place of business in _____, _____, hereinafter called "Principal" and _____, a Corporation of the State of _____, hereinafter called "Surety" are held and firmly bond unto the Tomball Independent School District, hereinafter called "Owner", for the use and benefit of all persons, firms and corporations who may furnish material or perform labor upon the buildings or improvements hereinafter referred to, in the penal sum of _____ ($_____) Dollars, (the Contract Price), in lawful money of the United States of America, to be paid in _____, Texas for payment of which sum well and truly to be made we bind ourselves and our successors, jointly and severally, by these presents.

TOMBALL WEST AGRICULTURAL SCIENCE FACILITY
FOR
TOMBALL INDEPENDENT SCHOOL DISTRICT

which said Contract and Documents referred to therein is herein now referred to and made a part hereof as fully and completely as if copies in detail herein.

NOW, THEREFORE, the condition of this obligation is such that if the Principal shall promptly make payment to all persons, firms and corporations furnishing materials for, or performing labor in the prosecution of the Work provided for in such Contract, and any extension or modification thereof, then this obligation shall be void; otherwise to remain in full force and effect.

Provided, however, that this bond is executed pursuant to the provisions of Texas Government Code Chapter 2253, and liabilities on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copies at length herein.

Provided, however, that nothing in the bond shall be construed to limit the rights of the beneficiaries of this Bond which they might have under general, special or the common law of the State of Texas not inconsistent with the terms hereof and not inconsistent with the provisions of Texas Government Code Chapter 2253, as amended.

Said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or of the Specifications accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of such change, extension of time, alteration or addition to the terms of the Contract or to the Work or to the Specifications thereunder.

No final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder whose claim may be unsatisfied, and it is expressly provided that if any legal action shall be filed upon this bond, venue shall lie in Harris County, Texas.

Simultaneously with the execution of this Payment Bond, the parties hereto have executed a Performance Bond, reference to which is made for all purposes. Nothing in this Payment Bond shall in any way invalidate or nullify the obligations of the parties as set forth in said Performance Bond.

IN TESTIMONY WHEREOF, the parties hereto have executed this instrument on this _____ day of _____, 20 _____.

_____
(Authorized Signature of Principal)

_____
(Title)

APPROVED AS TO FORM:

_____
Owner: Tomball Independent School District

_____
Attorney Representing Owner

_____
(Title)

ATTEST:

_____
(Secretary of Principal's Corporation)

_____
(Authorized Signature of Surety)

END OF SECTION

Section CD
Right of Audit - Examination of Records

.1 Records for all contracts, specifically including but not limited to lump sum contracts (i.e. fixed price or stipulated sum contracts), unit price, cost plus or time & material contracts with or without a guaranteed maximum (or not-to-exceed amounts) shall upon reasonable notice be open to inspection and subject to audit, scanning, and/or reproduction during normal business working hours. Such audits may be performed by any Owner's representative, or any outside representative engaged by Owner for the purpose of examining such records. The Owner or its designee may conduct such audits or inspections throughout the term of this contract and for a period of three years after final payment or longer if required by law. Owner's representatives may (without limitation) conduct verifications such as counting employees at the Construction Site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, subcontractors, and vendors.

.2 Contractor's "records" as referred to in this Exhibit shall include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in Owner's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records shall include (hard copy, as well as computer readable data if it can be made available), written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; change order files (including documentation covering negotiated settlements); backcharge logs and supporting documentation; invoices and related payment documentation; general ledger, information detailing cash and trade discounts earned, insurance rebates and dividends; and any other contractor records which may have a bearing on matters of interest to the Owner in connection with the contractor's dealings with the Owner (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of any or all of the following:

(a) Compliance with contract requirements for deliverables
(b) Compliance with approved plans and specifications
(c) Compliance with Owner's business ethics expectations
(d) Compliance with contract provisions regarding the pricing of change orders
(e) Accuracy of contractor representations regarding the pricing of invoices
(f) Accuracy of contractor representations related to claims submitted by the contractor or any of his payees.

.3 Contractor shall require all payees (examples of payees include subcontractors, material suppliers, insurance carriers, etc.) to comply with the provisions of this article by including the requirements hereof in a written contract agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum contracts) have the same right to audit provisions contained in this contract.

.4 Owner's authorized representative(s) shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this contract and shall be provided adequate and appropriate workspace, in order to conduct audits in compliance with this article.

.5 If an audit inspection or examination in accordance with this article, discloses overpricing or overcharges to the Owner (of any nature) by the Contractor and/or the Contractor's Subcontractors in excess of $100,000 in addition to making adjustments for the overcharges, the reasonable actual cost of the Owner's audit shall be reimbursed to the Owner by the Contractor. Any adjustments and/or payments

which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of Owner's findings to Contractor.

Section CD
Right of Audit – Records to Be Provided to Owner's Representatives Upon Request

In addition, to the normal paperwork documentation the Contractor typically furnishes to the Owner, in order to facilitate efficient use of Owner resources when reviewing and/or auditing the Contractor's billings and related reimbursable cost records, the Contractor agrees to furnish (upon request) the following types of information in the specified computer (PC) readable file format(s):

Type of Record	PC Readable File Format
Monthly Job Cost Detail	.pdf and Excel
Detailed job Cost History To Date	.pdf and Excel
Monthly Labor Distribution detail (if not already separately detailed in the Job Cost Detail)	.pdf and Excel
Total Job to date Labor Distrubution detail (if not already included in the detailed Job Cost History to date)	.pdf and Excel
Employee Timesheets documenting time worked by all individuals who charge reimbursable time to the project	.pdf
Daily Foreman Reports listing names and hours and tasks of personnel who worked on the project	.pdf
Daily Superintendent Reports	.pdf
Detailed Subcontract Status Reports (showing original subcontract value, approved subcontract change orders, subcontractor invoices, payment to subcontractors, etc.	.pdf and Excel
Copies of Executed Subcontracts with all Subcontractors	.pdf
Copies of all executed change orders issued to Subcontractors	.pdf
Copies of all documentation supporting all reimbursable job costs (subcontractor payment applications, vendor invoices, internal cost charges, etc.)	.pdf

SECTION 01 10 00

SUMMARY OF WORK

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work: The Project consists of the construction of a new agricultural science building for Tomball ISD as shown on the drawings and described in the project manual. The project also consists of a new competition soccer field with field house, press box and bleachers.

C. While the work is separated from other buildings on the site, no contact with students or staff will be permitted. Construction activities cannot impact the use of the site or any of the buildings/portions of buildings outside of the work area.

1.1 PROJECT INFORMATION

A. The Project, of which the work of this Contract is a part, is West Agricultural Science Facility for Tomball Independent School District at Berry Point Drive, Tomball, Texas 77433.

B. The project is under the jurisdiction of The City of Tomball, Texas.

PART 2 - PRODUCTS

2.1 PROJECT SCOPE DESCRIPTION

A. The New Work Includes:
- 01 Earthwork.
- 02 Concrete foundations and floor slabs.
- 03 Metal roof decking.
- 04 Masonry
- 05 Metal Panel Veneer
- 06 Hollow metal doors and frames.
- 07 Door hardware and access control system / devices.
- 08 Exterior glazing.
- 09 Suspended acoustical ceilings.
- 10 Interior finishes.
- 11 Specialties and equipment.
- 12 Pre-Engineered Metal Building.

B. New Sitework Includes:
- 01 Rough and final grading.
- 02 Imported select fill.

03 Concrete paving and sidewalks.
04 Underground storm, water and sanitary utilities.
05 Fencing.
06 Sports equipment.
07 Landscaping and irrigation system.
08 Aluminum walkway covers.

C. The MEP Work Includes:
01 HVAC systems.
02 New electrical service.
03 Plumbing.
04 Electrical power and lighting fixtures.
05 Communication systems.
06 Data infrastructure and wiring.
07 Fire alarm and security systems.

PART 3 - EXECUTION

3.1 SCHEDULE

A. Project Commencement: On-site work may commence in September 2025. Date may vary pending issuance of the notice to proceed.

B. Substantial Completion Time: The Owner has a critical need for the entire project to be substantially completed not later than May 15, 2026.

C. Proposer's submission of a Proposal for this Project shall be based on adhering to the above commencement and completion dates.
01 The Proposer's Contract amount shall include costs for all materials, equipment and labors required to achieve substantial completion by the designated date.

D. Refer to Tomball ISD RFP #987-25 - General Conditions and Supplementary Conditions related to liquidated damages for failure to substantially complete the project on or before the date stipulated above.

END OF SECTION

SECTION 01 21 00

ALLOWANCES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. The following ALLOWANCES shall be included in the Base Proposal. These sums shall be reconciled per Article 3.8 of the General Conditions.

1.2 CONDITIONS

A. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. These allowances shall cover the net cost of the materials and equipment delivered and unloaded at the site, and all applicable taxes.

01 The Contractor's handling costs on site, labor, installation, overhead, profit and other expenses contemplated for the original allowance shall be included in the Contractor's Base Proposal sum, and not in the allowance.

02 The Contractor shall cause the Work covered by these allowances to be performed for such amounts and by such persons as the Architect may direct, but he will not be required to employ persons against whom he makes reasonable objection.

03 If the cost, when determined, is more than the allowance, the Owner shall have the option of:

a. Supplementing funds in one allowance from another allowance to provide adequate funding.

b. Adjusting the Contract sum accordingly by Change Order, which will include Contractor’s overhead, profit and other expenses resulting to the Contractor.

B. Unexpended balance of allowance sums shall revert to the Owner in the final settlement Change Order of the Contract.

PART 2 - ALLOWANCES

2.1 ITEMS

A. Refer to Tomball ISD RFP #987-25 for allowances.

END OF SECTION

SECTION 01 22 00

UNIT PRICES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Contractor shall state, in the spaces provided in the Proposal Form, unit prices for the Work described below.
   02 The same unit price for each item shall be used for both adding or deleting the described work if / as directed by the Architect during the progress of the Work.
   03 Costs declared for Unit Prices shall be the gross amount used for adjustment, based on the actual quantity of units directed to be adjusted.

PART 2 – DESCRIPTION OF UNIT PRICES

2.1 GENERAL

A. For the Work described, unit pricing shall be used to determine the additional cost or credit to the Contract amount, or added to or deducted from the Owner's Contingency for changes in the Scope of Work made during the progress of the Work as directed by the Architect.

B. The same price shall be used for adding or deducting from the Scope of Work. No Exceptions.

C. The following unit prices shall be included on the proposal form and shall be included in the Owner - Contractor Agreement.

2.2 UNIT PRICES – SITE CONCRETE

A. Provide unit pricing for the following site concrete work, including subgrade prep:
   01 Add / Delete 60" Wide Sidewalks _____Lin. Foot (LF)
   02 Add / Delete Medium Duty (6") Concrete Paving _____Sq. Foot (SF)
   03 Add / Delete Heavy Duty (7") Concrete Paving _____Sq. Foot (SF)
   04 Add / Delete 6" Concrete Curb _____ Lin. Foot (LF)

2.3 UNIT PRICES – ELECTRICAL

A. Provide unit pricing for the following electrical work:

01 Add / Delete 120V duplex receptacle on nearest capable circuit _____ Each (EA)

02 Add / Delete 120V duplex receptacle on dedicated circuit, including 20 amp circuit breaker _____ Each (EA)

03 Add / Delete 220V receptacle on dedicated circuit including 20 amp circuit breaker _____ Each (EA)

04 Add / Delete two-way light switch _____ Each (EA)

05 Add / Delete three-way light switch _____ Each (EA)

2.4 UNIT PRICES – TECHNOLOGY

A. Provide unit pricing for the following technology work:

01 Add / Delete a single data port wired to nearest IDF / MDF room _____ Each (EA)

02 Add / Delete double data port wired to nearest IDF / MDF room _____ Each (EA)

03 Add / Delete triple data port wired to nearest IDF / MDF room _____ Each (EA)

04 Add / Delete j-box with 1-1/4” conduit stubbed Up wall to above ceiling _____ Each (EA)

2.5 UNIT PRICES – DOORS AND FRAMES

A. Provide unit pricing for the following door and frame work:

01 Add / Delete interior 3070 HM full flush door and HM frame, including painting _____ Each (EA)

END OF SECTION

SECTION 01 23 00

ALTERNATES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 The Contract Documents contain certain scopes of Work to be identified and priced separately by the Contractor.
   02 Alternate proposals are not included in the Contractors Base Proposal amount.
   03 Alternate proposals may be additive or deductive as determined by the Contractor.
   04 Acceptance or rejection of each Alternate shall be at the Owner's sole discretion.

1.2 ALTERNATE PRICES

A. Contractor shall state, in the spaces provided in the Proposal Form, alternate prices for the work described in the Alternate.
   01 Proposer's pricing for Alternates shall be the net change to the Base Proposal amount to include the cost of all supporting elements required to implement the described Alternate Scope of Work.
   02 Work for all Alternates shall be in strict accordance with the Specification and applicable work as indicated on the Drawings.

B. Unless otherwise indicated, Scope of Work for each Alternate shall include material and labor, general conditions, and all other costs, as applicable, associated with completing the Work described.

C. Alternates are not listed in the order of priority.

D. Acceptance of Alternates and inclusion in the Owner-Contractor Agreement shall be at the sole discretion of the Owner.
   01 Proposed pricing of Alternate Proposals shall be such that no matter what combination of Base Proposal and Alternates are accepted, the corresponding Contract amount shall be the total sum required to provide the full and defined Scope of Work.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF ALTERNATE PROPOSALS

A. ALTERNATE NO. 1 – BASE BID ADJUSTMENT (Optional)
The optional Alternate shall establish the amount to be voluntarily added/deducted from the Base Proposal Amount.

B. ALTERNATE NO. 2 – CATTLE PENS
The alternate shall establish the amount to be added/deducted from the Base Proposal Amount to furnish and install small animal and cattle pens. Built-in arena pens and poultry pens are to be included in the base bid and are not included in this alternate.

END OF SECTION

SECTION 01 25 00

REQUEST FOR SUBSTITUTION PROCEDURES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Each Specification Section includes products, materials and / or equipment incorporated into the Scope of Work as the “Basis of Design”, as well as listed other acceptable manufacturers / providers.
   02 Substitutions Prior To Award of Contract: Procedures and required documentation for a request for substitution of products, materials and / or equipment from those required by the Contract Documents.
   03 Substitutions After Award of Contract: Procedures and required documentation for a request for substitution of products, materials and / or equipment from those required by the Contract Documents.
      a. The Scope of Work is based products, materials and equipment used for the Basis of Design which the Owner has approved.
      b. Except for other provisions included in the Contract, in order to receive due consideration, requests for substitution after award of Contract should be accompanied with incentive – financial or schedule – to the Owner for accepting the substitution.
   04 No consideration will be given to requests for substitution for products, materials and / or equipment that is described as “no substitutions”.

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. In order for a request for substitution to be considered, submit the following to the Architect as a single, concise complete package.
   01 Incomplete, vague or ambiguous packages will not be considered and result in the request being denied.

C. Substitution Request Form (attached at end of this Section)
   01 Two forms are attached at the end of this Specification Section:
      a. Substitution Request Form – Pre-Contract Award
      b. Substitution Request form – Post-Contract Award
   02 Submit the appropriate form, fully executed.

D. Specification Section: Return the complete Specification Section with the following:
   01 Each and every paragraph, statement and description clearly initialed to signify the proposed substitution will meet or exceed the specified requirement.

02 For any of the proposed substitution deviation of any requirement or provision of the Specification, clearly describe what is proposed if the substitution is accepted.

E. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
01 Pertinent product data must be clearly indicated; and conversely, product data that is not applicable must be clearly marked out or indicated as not applicable.
02 Architect's review shall not include interpretation of vague or ambiguous product data.

F. Shop Drawings:
01 Provide Shop Drawings and / or details that depict the proposed substitution as it would be incorporated into the Work.
02 Details submitted for review shall be specific to the Work of this Contract and shall accurately depict adjacent and interfacing products / materials within the assembly(s) indicated on the Drawings.
03 Generic details that do not accurately depict the Project's adjacent or interfacing work shall not be accepted; and result in disapproval of the requested substitution.

G. Color / Finish Samples: For substitution requests relating to finished exterior or interior products, submit the following:
01 Provide two (2) samples of each proposed finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3" x 3", but must be large enough to convey attributes of the proposed product.
04 For finishes that have been specifically indicated in the Contract Documents, submit proposed finish samples that match or closely approximate the specified material.
05 For brick veneer provide each type of proposed brick to be provided in quantities sufficient to show range of color where applicable.

PART 2 – SUBSTITUTION SUBMISSION REQUIREMENTS

2.1 REQUEST FOR SUBSTITUTION – PRE-CONTRACT AWARD

A. All requests for substitution packages submitted Pre-Contract Award (during bidding / proposal phase) must be submitted to the Architect a minimum of ten (10) days prior to receipt of bids / proposals.
01 Requests for substitution packages submitted less than ten (10) days prior to receipt of bids / proposals shall not be reviewed.

B. It is the sole responsibility of the submitter to confirm the submission is complete and accurate.
01 Incomplete or inaccurate substitution packages may be rejected without notification to the submitter.
02 The Architect shall have sole discretion to inform or not inform the submitter of any information missing from the substitution package.

C. In order for a substitution package to be considered, the following are required:

01 Substitution request must be fully documented and properly submitted within the specified time.
02 Substitutions must be completely compatible and properly interface with other portions of the Work.
03 Substitution must provide specified warranty.

D. All substitutions approved by the Architect prior to submission of bids / proposals shall be incorporated into the Contract Documents by Addendum.

E. Substitutions not added to the Contract Documents by Addendum may be submitted by a General Contractor / Proposer as a supplemental qualification to his Base Bid / Base Proposal.
01 Under this condition, the Base Bid / Base Proposal submitted by the General Contractor / Proposer must be based on the Contract Documents.
02 The General Contractor / Proposer may submit a clearly stated qualification to the Base Bid / Proposal relative to the substitution for consideration.
03 The stated qualification must include a statement of financial or project schedule incentive to the Owner in order for the qualified substitution to be considered.
04 The stated qualification must include what impact, if any the substitution has on adjacent or interfacing work.
05 The stated qualification must include a written statement from the General Contractor / Proposer that he has fully investigated the proposed substitution and will accept responsibility of the substitution for inclusion in the Project.

2.2 REQUEST FOR SUBSTITUTION – POST-CONTRACT AWARD

A. If allowed by the Contract or Contract Documents, requests for substitution post-Contract Award may be considered by the Architect under the following conditions:
01 The Basis of Design product, material or equipment is no longer available.
02 The product, material or equipment is no longer available from a listed acceptable manufacturer.
03 The proposed substitution shall result in a financial or schedule incentive to the Owner should it be accepted.

B. Unless otherwise agreed to by the Architect, the Contractor shall allow a minimum of twenty-one (21) days for A/E review of requests for substitution Post-Contract Award.

C. It is the sole responsibility of the Contractor and submitter to confirm the submission package is complete and accurate.
01 Incomplete or inaccurate request for substitution packages may be rejected without a completed review by the Architect.

D. In order for a substitution package to be considered, the following are required:
01 Substitution request must be fully documented and properly submitted within the specified time.
02 Substitutions must be completely compatible and properly interface with other portions of the Work.
03 The substitution package must include documentation of any resultant impact to adjacent or interfacing work.

E. All substitutions approved by the Architect Post-Contract Award shall be incorporated into the Contract Documents by appropriate documentation (i.e. CPR, AEA, ASI or similar) as a matter of record.

PART 3 – REQUEST FOR SUBSTITUTION FORMS

REQUEST FOR SUBSTITUTION FORM – PRE-CONTRACT AWARD

Project Name: Tomball West Agricultural Science Facility
Arcadis Inc. Project No.: 202414

We hereby submit for your consideration this Request for Substitution for the following product, material and / or equipment included in the Contract Documents for the above Project:

Specification Section: _____ Specific Paragraph (as applicable): _____

Specification Name: _____

Specified Manufacturer: _____ Model No.: _____

Proposed Manufacturer**:** _____ Model No.: _____

All attached supporting documentation is confirmed to be complete and accurate, and in accordance with the submittal requirements of this Section.

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be readily available for the proposed substitution.

SUBMITTED BY:

_____ _____
Signature *Contact Phone Number*

_____ _____
Printed Name and Title *Contact Email Address*

_____
Company Name

_____ _____
Company Address *City, State and Zip Code*

REQUEST FOR SUBSTITUTION FORM – POST-CONTRACT AWARD

Project Name: Tomball West Agricultural Science Facility
Arcadis Inc. Project No.: 202414

We hereby submit for your consideration this Request for Substitution for the following product, material and / or equipment included in the Contract Documents for the above Project:

Specification Section: _____ Specific Paragraph (as applicable): _____

Specification Name: _____

Specified Manufacturer: _____ Model No.: _____

Proposed Manufacturer**:** _____ Model No.: _____

Reason for Substitution Request: _____

_____

Associated Owner Incentive: _____

All attached supporting documentation is confirmed to be complete and accurate, and in accordance with the submittal requirements of this Section.

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be readily available for the proposed substitution.

SUBMITTED BY:

_____ _____
Signature *Contact Phone Number*

_____ _____
Printed Name and Title *Contact Email Address*

_____
Company Name

_____ _____
Company Address *City, State and Zip Code*

CONTRACTOR:

_____
Signature

_____
Printed Name and Title

END OF SECTION

SECTION 01 26 00

CONTRACT ADMINISTRATION DOCUMENT MANAGEMENT

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

.

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
This section describes procedures to be followed for processing the following documents:
01 RFI – Request for Information.
02 ASI – Architect's Supplemental Instructions.
03 CPR – Change Proposal Request.
04 PCR – Potential Change Request.
05 AEA – Allowance Expenditure Authorization.
06 CCD – Construction Change Directive.

C. Related Sections:
01 Section 01 21 00 – Allowances
02 Section 01 25 00 - Request for Substitution Procedures
03 Section 01 29 76 – Progress Payment Procedures
04 Section 01 33 00 – Submittal Procedures
05 Section 01 77 00 – Close-Out Procedures

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. All documents included in the scope of this Section shall be processed through the Owner's document management software. (Project Mates)

C. Documents originating from the Contractor may be distributed directly to Architect's Consultants, as applicable, provided designated Architect team members are copied or included in the transmission.

D. Documents originating from the Architect shall be distributed directly to Contractor's designated team members.

E. Inclusion of Owner with respect to transmissions shall be determined at the pre-construction conference prior to commencement of Work.

F. The Contractor shall keep up-to-date logs of the documents included in the scope of this Section.
01 Logs shall include document type, number, subject, submission date, requested response date, actual response date, cost impact, contract time impact, and status as applicable (i.e. pending, approved, not approved, voided)

02 Contractor shall provide copies of logs to attendees at Owner-Architect-Contractor (OAC) regular meetings.

PART 2 - DOCUMENTATION

2.1 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information, clarification or interpretation of the Contract Documents, Contractor shall initially correspond with the Architect's field representative to resolve the issue.
   01 If resolution is not determined by the Architect's field representative, prepare, and submit an RFI in the form specified using the Architect's electronic project document management software.
   02 Issues resolved at the Architect's Field Representative level which results in a Contractual Minor Change or Clarification shall be documented by the Architect as appropriate to the change.

B. RFI's must originate from the Contractor. Architect will not accept RFIs submitted by subcontractors or other entities controlled by Contractor.
   01 The Contractor shall endeavor to resolve subcontractor submitted RFI's directly with the subcontractor prior to submitting an RFI to the Architect.

C. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's Work or Work of subcontractors.

D. Contractor uses the RFI to request direction and / or clarification resulting from, but not limited to the following:
   01 Conflicts, omissions, ambiguities, or discrepancies within the Contract Documents.
   02 Conflicts between the Contract Documents and any provision of code or regulation applicable to the performance of the Work.
   03 Conflicts between the Contract Documents and any standard Specification or instruction of a manufacturer.
   04 Conflicts with differing existing conditions.

E. Content of RFI:
   01 Drawing sheet number reference, building area, room number and / or other specific description of the location of the issue; as appropriate.
   02 Specification Section number, page number, paragraph number and item number of the location of the issue; as appropriate.
   03 A detailed description of item needing information, clarification or interpretation.
   04 Attachments: Include sketches, descriptions, measurements, photos, product data, Shop Drawings, Coordination Drawings, and other information necessary to fully describe items needing interpretation.
   05 Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
   06 Field dimensions and / or conditions; as appropriate.
   07 Photographs of issue in question; as appropriate.
   08 Contractor's proposed / recommended resolution.
   09 Statement identifying one of the following:
      a. No Cost Impact
      b. Cost Impact Unknown
      c. Cost Impact Anticipated
   10 Statement identifying one of the following:
      a. No Contract Time Impact
      b. Contract Time Impact Unknown

c. Contract Time Impact Anticipated

F. Architect's Actions:
01 Architect will review each RFI, determine action required, and respond.
02 Allow up to five (5) working days for Architect's response for each RFI. If the Contractor believes a faster response time is necessary in order to maintain schedule, it must be clearly indicated on the RFI.
03 The following RFIs will be returned without action:
a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for coordination information already indicated in the Contract Documents.
d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Incomplete RFIs or inaccurately prepared RFIs.
04 Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
05 If Contractor believes the RFI response warrants change in the Contract Sum or the Contract Time, Contractor must notify Architect in writing within three (3) working days of receipt of the RFI response.
a. Failure of notification within the specified time frame shall be Contractor's concurrence that implementation of the Architect's response does not result in a change to Contract Sum or Contract Time.
06 Architect's action on RFIs that may result in a change to the Contract Sum or the Contract Time may be eligible for Contractor to submit Potential Change Request to the Architect for consideration.

2.2 ARCHITECT'S SUPPLEMENTAL INSTRUCTION (ASI)

A. General: ASI's are instruments initiated by the Architect and submitted to the Contractor regarding clarifications, interpretations and / or minor changes in the Work that are consistent with the Contract Documents and do not affect the Contact Sum or the Contract Time.
01 ASI's may also be used to contractually document an issue that was initially resolved on site between the Contractor's superintendent and the Architect's field representative.
02 ASI's shall be initiated and processed using the Architect's electronic project document management software.

B. Content of ASI:
01 Drawing sheet number reference, building area, room number and / or other specific description of the location of the issue; as appropriate.
02 Specification Section number, page number, paragraph number and item number of the location of the issue; as appropriate.
03 A detailed description of item needing information, clarification or interpretation.
04 Attachments: sketches, descriptions, measurements, photos, product data, Shop Drawings, Coordination Drawings, and other information necessary to fully describe items needing interpretation.
05 Dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Contractor's Action:
   01 The Contractor shall expeditiously distribute the ASI directive to all affected parties / subcontractors as required for the ASI directive to be implemented into the Work.
   02 Failure by the Contractor to expeditiously distribute the ASI directive which subsequently results in a claim for additional cost shall preclude any consideration of the claim.
   03 The Contractor shall coordinate all affected trades and make all necessary adjustments to project scope and schedule required to implement the ASI change at the appropriate time.
   04 If the Contractor fails to properly implement the ASI change at the appropriate time, all subsequent costs required to achieve proper implementation of the ASI change shall be solely at the Contractor's expense.
   05 The Contractor shall document the ASI directive on the Record Drawings kept at the site.

D. If Contractor believes the ASI directive(s) warrants change in the Contract Sum or the Contract Time, Contractor must notify Architect in writing within three (3) working days of receipt of the ASI.
   01 Failure of notification within the specified time frame shall be Contractor's concurrence that implementation of the Architect's ASI directive(s) does not result in a change to Contract Sum or Contract Time.
   02 Upon notification, one of the following shall be implemented, as agreed upon by Architect, Owner and Contractor:
      a. The Contractor shall issue a Potential Change Request (PCR) stating the proposed additional cost and / or change in contract time; or,
      b. The Architect shall convert the ASI to a Change Proposal Request (CPR) to allow the Contractor to respond; or,
      c. The Architect shall convert the ASI to a Construction Change Directive (CCD) if required for timely implementation.

2.3 CHANGE PROPOSAL REQUEST (CPR)

A. General: CPR's are instruments initiated by the Architect and submitted to the Contractor regarding changes in the Contract Documents that may result in a change in the Contact Sum or the Contract Time.
   01 CPR's may be issued for the following:
      a. Addition, deletion or modification of the scope of Work.
      b. Implementation of Owner initiated changes.
      c. Document legitimate notifications from Contactor regarding potential change in the Contract Sum or Contract Time due to Architect's response to an RFI or Architect's issuance of an ASI.
   02 CPR's shall be initiated and processed using the Architect's electronic project document management software.

B. Content of CPR:
   01 Drawing sheet number reference, building area, room number and / or other specific description of the location of the CPR subject; as appropriate.
   02 Specification Section number, page number, paragraph number and item number of the location of the CPR subject; as appropriate.
   03 A detailed description or directive of the revision of the Contract Documents.
   04 Attachments: sketches, descriptions, measurements, photos, product data, Shop Drawings, Coordination Drawings, and other supporting documentation necessary to fully describe the change in the scope of the Work.
   05 The CPR shall indicate how the CPR will be funded by the Owner.

C. Contractor's Action:
   01 The Contractor shall expeditiously distribute the CPR to all affected parties / subcontractors as required for pricing of each affected trade.
   02 Failure by the Contractor to expeditiously distribute the ASI directive which subsequently results is a claim for additional cost shall preclude any consideration of the claim.
   03 For all approved CPR's, the Contractor shall document the CPR on the Record Drawings kept at the site.

D. Contractor's CPR Response:
   01 The Contractor shall endeavor to provide CPR responses within (ten) 10 working days from receipt of the CPR.
   02 The Contractor shall provide detailed cost and / or credit documentation for all CPR's.
   03 Provide a cover letter stating the overall cost / credit impact and all adjustments to Contract Time.
   04 Responses that include a change in Contract Time must be accompanied by a detailed description of how the scope of Work in the CPR affects the critical path of the Contractor's schedule. Proposed changes in Contract Time must affect the critical path in order to be considered.
   05 Cost changes that are included in the Contract as unit prices must use the unit price amounts.
   06 Cost changes shall reflect the allowable mark-ups in accordance with the Conditions of the Contract.
   07 In addition to the cover letter, the CPR response must include the following:
      a. Detailed spreadsheet, including materials and labor, for all work proposed to be self-performed by the Contractor.
      b. A detailed breakdown, including materials and labor, from each subcontractor responding to the CPR.
   08 Prior to submission of the CPR response to the Architect for review, the Contractor shall thoroughly review all subcontractor responses and verify the following:
      a. All interpretations of scope are accurate.
      b. Unit pricing has been used where applicable in accordance with the Contract.
      c. Material take-offs are accurate.
      d. Labor units / hours are fairly assigned.
      e. Subcontractor mark-ups are in accordance with the Conditions of the Contract.
      f. Taxes have not been added where prohibited for tax-exempt projects.
   09 For CPR's to be funded by an allowance, no mark-up by the Contractor is permitted. For CPR's to be funded by Change Order, the Contractor's mark-up shall be in accordance with the Conditions of the Contract.

E. Architect's Review of CPR Response:
   01 Upon receipt of the Contractor's CPR response, the Architect shall review all documentation included in the response.
   02 Questions or request for additional information regarding the response shall be directed to the Contractor as needed. The Contractor shall promptly respond to Architect's questions or request for additional information.
   03 Upon final review, the Architect shall make recommendation to the Owner for acceptance or rejection of the CPR and related scope of work.
      a. Where the Contractor's response includes both a Contract Sum and Contract Time adjustment, the Architect may recommend acceptance of the cost and rejection of the time where the requested time extension does not affect the critical path of the project.

04 If approved / accepted by the Owner, the CPR shall be included on a future Allowance expenditure Authorization (AEA) or Change Order.

2.4 ALLOWANCE EXPENDITURE AUTHORIZATION (AEA)

A. General: AEA's are instruments initiated by the Architect and submitted to the Contractor and Owner for approval to fund CPR changes in the Contract Sum and / or changes in the Contract Time where the funding source is an Allowance included in the Contract.
   01 AEA's shall be initiated and processed using the Architect's electronic project document management software.

B. Approved expenditures to be funded by an allowance shall be documented by an AEA specific and exclusive to that particular allowance.

C. AEA's may be used to transfer funds from one allowance to another allowance.

D. Each AEA shall include attachment of all CPR expenditures or CPR credits included in the AEA.
   01 A summary of expenditures for the respective allowance shall be included in each AEA.

E. The AEA shall also include documentation of any adjustment in Contract Time which is being approved.

F. At the Owner's discretion and direction, the Contractor may proceed with approved Work included in a CPR prior to final production and execution of an AEA. Such direction to proceed with Work shall be made in writing to the Contractor for record.

G. The Contractor shall document allowance expenditures on progress applications for payment in accordance with **Section 01 29 76 – Progress Payment Procedures**.

2.5 CONSTRUCTION CHANGE DIRECTIVE (CCD)

A. General: CCD's are instruments initiated by the Architect and submitted to the Contractor and Owner for approval to direct the Contractor to proceed with Work prior to Owner's final acceptance of Contractor's proposed changes in the Contract Sum and / or changes in the Contract Time.
   01 CCD's are primarily issued to eliminate impact to the Contractor's schedule for the directed Work for the following reasons:
      a. Final agreement on cost has not been achieved.
      b. Final agreement on time extensions has not been achieved.
      c. Final Owner approval of the change document has not been achieved (i.e. school board action required at a regular board meeting).
   02 CCD's shall be signed by all parties – Owner, Architect and Contractor – upon issuance.
   03 CCD's shall be initiated and processed using the Architect's electronic project document management software.

B. Contractor's Action:
   01 Upon receipt of a CCD, the Contractor shall expeditiously distribute the CCD to all affected parties / subcontractors as required for implementation of the directed Work.

02 Failure by the Contractor to expeditiously distribute the CCD directive which subsequently results is a claim for additional cost shall preclude any consideration of the claim.

C. Contractor's Final Pricing for CCDs:
   01 The CCD shall include information of how final costs shall be determined.
   02 The CCD shall include information regarding consideration for any allowance of extensions of Contract Time.
   03 If final cost is to be determined on a time and material basis, Contractor shall maintain and furnish detailed records of all time, employee activities and material expenses associated with the CCD.
      a. Upon agreement by the Owner and Contractor, the CCD may include a "Not to Exceed" amount relative to a time and material cost basis.
   04 If a CCD is issued due to disagreement on the Contractor's proposed pricing of a CPR or PCR, the disputed pricing of the CPR or PCR response shall represent the Contractor's maximum cost to implement the CCD directed Work.
   05 If a CCD is issued due to disagreement on the Contractor's request for extension of time relative to a CPR or PCR, the disputed extension of time of the CPR or PCR response shall represent the Contractor's maximum extension of time to implement the CCD directed Work.

D. Upon completion of the CCD directed Work, if the final Contractor's submitted cost and / or request for extension of time is not agreed upon by the Owner, the Contractor may pursue other claim remedies in accordance with the Contract.

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 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.

C. Related Work:
   01 Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   02 Section 01 29 76 – Progress Payment Procedures
   03 Each Specification Section shall be used to determine requirements and breakdown of the schedule of values.

1.2 SUBMITTALS

A. Schedule of Values - Draft: Prior to the first application for payment, and within thirty (30) calendar days after execution of the Owner-Contractor Agreement, submit a proposed schedule of values to the Architect, as outlined below, for review.
   01 The schedule of values is represented in Column C of the AIA G702/G703 – Application for Payment.

B. Coordinate with the Architect and determine what additional breakdown, if any, is required to be submitted for final approval.

C. Secure the Architect's approval of the schedule of values prior to submitting the first Application for Payment.

D. Schedule of Values – Final: Upon approval by the Architect, the final schedule of values shall be submitted for review and acceptance.
   01 Once established, the schedule of values shall not be altered, except for the execution of a Change Order to the Contract.

1.3 QUALITY ASSURANCE

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

B. When so requested by the Architect, provide copies of the subcontracts or other data acceptable to the Architect, substantiating the line item amounts in the schedule of values.

C. At a minimum, the schedule of values shall be broken down into costs for each Specification Section as labor and materials.
   01 Where Specification Sections cover multiple Scopes of Work or products, the schedule of values shall reflect each scope / product separately.

D. The Contractor is encouraged to make the schedule of values very detailed in order to facilitate review and approval of requested percentages complete on Pay Applications.
   01 Where breakdown is vague, or includes multiple / combined assemblies, stages, tasks, etc., Architect's review shall be conservative in favor of the Owner regarding approval of Pay Applications.

PART 2 - PRODUCTS

2.1 APPLICATION FOR PAYMENT SCHEDULE OF VALUES

A. The schedule of values, once approved shall be transferred to Columns B and C of AIA G702/G703 – Application for Payment to be used for all progress payments.

B. Once AIA G702/G703 – Application for Payment has been submitted for payment, individual line item amounts in Column C must remain unchanged throughout the progress of the Work.

C. In the beginning stages of the construction, total amounts for entire Divisions may be used if complete breakdowns are not available; and shall be line item populated as soon as practical.

D. No payments will be approved in Divisions that do not have a line item breakdown.

E. Allowances shall be shown, and remain throughout construction, as a single line item on the Master Application for Payment in amount(s) as stipulated in the Contract Documents.

F. For each Allowance, expenditures and accounting shall be included on a separate, attached spread sheet of the same format as the Master Application for Payment.

G. The Master Application for Payment shall reflect only the summary of each Allowance; and shall not contain individual Allowance activity(s).

2.2 SCHEDULE OF VALUES - ALTERNATES

A. For accepted Alternates which are "stand alone" Scopes of Work, separately indicate each Alternate with its own corresponding schedule of values.

B. For accepted Alternates that are integrated into multiple trades performing the Work, adjust individual line item schedule of values to reflect the scope of the Alternate.

C. Coordinate with the Architect as required.

2.3 SCHEDULE OF VALUES FOR ALLOWANCE EXPENDITURES

A. Each Owner approved allowance in the Contract shall be stated as a single line item in the schedule of values.

01 The scheduled value in Column C shall be the total of the Allowance and shall remain constant throughout the progress of the Work.

B. In addition to the Master Application for Payment, for each Allowance, the Contractor shall develop a separate, supplemental spreadsheet in the same format as AIA G703 that shall track approved expenditures of the Allowance.

C. Each approved Allowance expenditure item shall be listed separately with the authorized / scheduled value identified in Column "C" on the supplemental Allowance spreadsheet.

D. Progress on each expenditure shall be tracked on the supplemental spreadsheet (i.e. previously billed, Work this period, overall completion percentage, etc.).

E. The Master Application for Payment shall include ONLY summary totals from each Allowance supplemental spreadsheet for each Pay Application period.

2.4 SCHEDULE OF VALUES

A. Schedule of values for Specification Division 2 through 33 shall be broken down for each separate section of work, and include multiple items / Scopes of Work covered where appropriate.
   01 Each item of Work shall be broken down by material and labor at a minimum.
   02 Where payment for Shop Drawings, submittals, Record Drawings and similar are expected to be billed separately, the items must be included as a standalone item on the schedule of values.

B. In order for a subcontractor / trade to invoice for the following items, each item must be listed separately under the appropriate section of their respective work:
   01 Mobilization
   02 Overhead & supervision
   03 Submittals / Shop Drawings
   04 Coordination Drawings
   05 Operations and maintenance manuals
   06 Close-out documentation

C. For projects that include work on multiple buildings, each building's Scope of Work shall be listed separately on the schedule of values.

D. For larger projects, the schedule of values shall be broken down by building areas (i.e. A, B, C, D, etc.) and floor (1st, 2nd, etc.) as identified on the Drawings for the following Scopes of Work.
   01 Division 3 – Concrete
   02 Division 5 – Structural Steel
   03 Division 7 – Roofing
   04 Division 21 – Fire Protection
   05 Division 22 – Plumbing
   06 Division 23 – Mechanical
   07 Division 26 – Electrical
   08 Division 27 – Communications / IT

2.5 SCHEDULE OF VALUES BREAKDOWN

A. Schedule of Values – The following shall represent the minimum breakdown of line items; and shall include material and labor for each item where applicable:

DIVISION 1 – GENERAL CONDITIONS
01 Building Permits
02 Bonds
03 Insurance
04 General Contractor's Fee
05 General Contractor's Overhead
06 Supervision
07 Mobilization
08 Temporary Facilities
09 Temporary Fencing
10 SWPPP
11 General Cleaning
12 Final Cleaning
13 Close-Out Documents
14 Operation and Maintenance Manuals
15 Record Drawings
16 MEP Coordination Drawings
17 Allowances (list each separately)
18 Alternates (list each separately as applicable)

DIVISION 2 – EXISTING CONDITIONS
01 Selective Demolition

DIVISION 3 – CONCRETE
01 Below Slab Vapor Membrane
02 Drilled Piers / Spread Footings
- a. Formwork
- b. Reinforcement
- c. Concrete
- d. Placement

03 Grade Beams
- a. Formwork
- b. Reinforcement
- c. Concrete
- d. Placement

04 Slab on Grade
- a. Formwork
- b. Reinforcement
- c. Concrete
- d. Placement

DIVISION 4 – MASONRY
01 Project Coordination Drawings
02 Masonry Restoration
03 Masonry Ties
04 Brick Veneer – Exterior
05 CMU
06 Masonry Cleaning
07 Water Repellant

DIVISION 5 – METALS
01 Steel Shop Drawings
02 Project Coordination Drawings
03 Structural Steel
04 Structural Steel Erection

05 Steel Joists
06 Light Gage Steel Framing
07 Metal fabrications
08 Pipe and Tube Railing

DIVISION 6 – WOOD AND PLASTICS
01 Rough Carpentry
02 Finish Carpentry

DIVISION 7 – THERMAL AND MOISTURE PROTECTION
01 Elastomeric Waterproofing
02 Shower Stall Waterproofing
03 Building Insulation
04 Metal Roofing
05 Metal Wall Panels
06 Sheetmetal Flashing
07 Roof Accessories
08 Roof Hatches and Vents
09 Penetration Fire-stopping
10 Fireproofing
11 Joint Sealants

DIVISION 8 – DOORS AND WINDOWS
01 Hollow Metal Frames
02 Hollow Metal Doors
03 Aluminum Doors and Frames
04 Plastic Laminate-Faced Wood Doors
05 Access Doors and Frames
06 Overhead Coiling Doors
07 Finish Hardware
08 Glazed Systems – Framing
09 Glazed Systems – Glazing
10 Louvers and Vents

DIVISION 9 – FINISHES
01 Project Coordination Drawings
02 Gypsum Board Assemblies – Walls
   a. Metal Framing
   b. Gypsum Board
   c. Taping and Floating
03 Metal Framing – Ceilings
   a. Metal Framing
   b. Gypsum Board
   c. Taping and Floating
04 Ceramic Tile
05 Acoustical Ceilings
06 Slip Resistant Coatings
07 Concrete Floor Sealer
08 Resilient Tile Flooring
09 Carpet
10 Cementitious Wood Fiber Wall Panels
11 Sound Absorbing Wall Units
12 Painting

DIVISION 10 – SPECIALTIES
01 Miscellaneous Specialties
02 Marker Boards
03 Tack Boards
04 Display Cases
05 Exterior Signage
06 Interior Signage
07 Toilet Partitions
08 Wire Mesh Partitions
09 Demountable Partitions
10 Corner Guards
11 Bumper Guards / Chair Rail
12 Toilet and Bath Accessories
13 Fire Extinguishers and Cabinets
14 Metal Lockers
15 Wood Benches
16 Aluminum Walkway Covering
17 Steel Walkway Coverings

DIVISION 11 – EQUIPMENT
01 Residential Appliances
02 Food Service Equipment
03 Laboratory Equipment
04 Vocational Shop Equipment

DIVISION 12 – FURNISHINGS
01 Horizontal Blinds
02 Manufactured Plastic-Laminate-Clad Casework
03 Laboratory Casework
04 Performing Arts Casework
05 Entrance Floor Mats and Frames
06 Library Furniture
07 Upholstered Audience Seating
08 Telescoping Bleachers
09 Table and Chair Assemblies
10 Site Seating and Tables
11 Bicycle Racks

DIVISION 13 – SPECIAL CONSTRUCTION
01 Metal Building Systems
02 Wall Panels for Pre-Engineered Buildings
03 Roof Panels For Pre-Engineered Buildings

DIVISION 14 – CONVEYING SYSTEMS

DIVISION 21 – FIRE PROTECTION
01 Project Coordination Drawings
02 Fire Alarm Devices
03 Fire Alarm Wiring
04 Fire Sprinkler Equipment
05 Fire Sprinkler Piping
06 Fire Sprinkler Fixtures
07 Fire Sprinkler Trim-Out

DIVISION 22 - PLUMBING
01 Project Coordination Drawings
02 Under Slab Sanitary
03 Bentonite Dams At Trenches
04 Above Slab Sanitary
05 Above Slab Water
06 Plumbing Fixtures
07 Plumbing Trim-Out

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING
01 Project Coordination Drawings
02 Rigid Ductwork
03 Flexible Ductwork
04 Grilles and Diffusers
05 Mechanical Trim Out
06 Air Handlers
07 Condensing Units

DIVISION 26 –ELECTRICAL
01 Project Coordination Drawings
02 Panelboards
03 Transformers
04 Site Underground Electrical
05 Site Lighting
06 Under Slab Electrical
07 Bentonite Dams At Trenches
08 Electrical Rough-in – Power
09 Electrical Rough-in – Lighting
10 Power Devices
11 Light Fixtures
12 Electrical Trim Out
13 Data and Technology
14 Communication System
15 Security System – Video
16 Security System - Intrusion
17 CATV System

DIVISION 31 – EARTHWORK
01 Site Clearing
02 Excavation, Fill and Earthwork
03 Site Drainage / Erosion Control
04 Bentonite Dams At Trenches
05 Rough Grading
06 Finish Grading
07 Storm Drainage
08 Site Water Utilities
09 Site Sanitary Sewer
10 Lime Stabilization

DIVISION 32 – EXTERIOR IMPROVEMENTS
01 Concrete Paving
02 Lime Stabilization
03 Curbs
04 Sidewalks / Miscellaneous Concrete Flatwork
05 Chain Link Fencing

B. The following work shall be listed as a separate line item if the sub-contractor anticipates invoicing separately for the work:
   01 Mobilization
   02 Subcontractor temporary facilities
   03 Subcontractor Bonds
   04 Submittals
   05 Shop Drawings
   06 Rough-In
   07 Fixtures / Equipment
   08 Trim-Out
   09 Close-Out Documents / Record Drawings

2.6 SCHEDULE OF VALUES FOR ALLOWANCE EXPENDITURES

A. For Owner approved expenditures from Allowances included in the Contractor's Proposal, the Application for Payment shall include a separate, supplemental spreadsheet in the same format as AIA G703.
   01 Provide a separate supplemental spreadsheet for each Allowance included in the Contract.

B. Each approved Allowance expenditure item shall be listed separately with the authorized / scheduled value identified in Column "C".

C. Progress on each expenditure shall be tracked on the supplemental spreadsheet (i.e. previously billed, work this period, overall completion percentage, etc.).

D. The Master Application for Payment shall include ONLY totals from each Allowance supplemental spreadsheet for each application period.

END OF SECTION

SECTION 01 29 76

PROGRESS PAYMENT PROCEDURES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 This Section establishes the procedures for submitting progress Pay Applications during the Contract Administration phase.

C. Related Work:
   01 Documents affecting Work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   02 Section 01 29 73 – Schedule of Values.

1.2 SUBMITTALS

A. Provide draft application for each Pay Application to the Arcadis Field Representative.

B. Provide progress Pay Applications in accordance with the Owner-Contractor Agreement.

C. Submission of Pay Applications in either hard copy and / or electronic format shall be defined in the Owner-Contractor Agreement or at the pre-construction meeting.

1.3 QUALITY ASSURANCE

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

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

C. The Schedule of Values shall be broken down into costs for each Specification Section as labor and materials at a minimum.
   01 The Contractor is encouraged to make the schedule of values very detailed in order to facilitate review and approval of requested percentages complete on Pay Applications.
   02 Where breakdown is vague, or includes multiple / combined assemblies, stages, tasks, etc., Architect's review shall be conservative in favor of the Owner regarding approval of Pay Applications.

1.4 MULTIPLE PHASES / BUILDINGS AND ALTERNATES

A. For projects consisting of multiple phases, separate each phase on the Application for Payment and include separate Division 1 through 32 line-items for each phase.

B. For projects consisting of multiple buildings, separate each building on the Application for Payment and include separate Division 2 through 28-line items for each building.

C. If applicable to multi-phase / multi-buildings projects, site work may be shown separately from phases and / or buildings. Coordinate with Architect as required for approval.

D. Owner accepted Alternates which are “stand alone” Scopes of Work, not integrated into the Base Bid / Proposal Scope of Work, shall be listed separately with each Alternate having its own corresponding schedule of values.

PART 2 - PRODUCTS

2.1 APPLICATION FOR PAYMENT

A. Application for Payment shall be made using AIA G702/G703 – Application for Payment to be used for all progress payments.
   01 Other non-AIA programs proposed by the Contractor may be considered; however, the formatting and content must match AIA G702/G703.

B. Once AIA G702/G703 – Application for Payment has been submitted for payment, individual line-item amounts in Column C ***must remain unchanged throughout the progress of the Work***.
   01 In the beginning stages of the construction, total amounts for entire Divisions may be used if complete breakdowns are not available; and shall be line-item populated as soon as practical.
   02 No payments will be approved in a Division that does not have a complete, approved line-item breakdown.

C. Format of listed line-items of Application for Payment shall sequentially follow the CSI format of the Specifications.

2.2 OWNER ALLOWANCE EXPENDITURES

A. The primary Application for Payment shall include a single line item for each Owner Allowance included in the Contract, with the total allowance amount stated in Column C.

B. The Application for Payment shall include a separate, supplemental spreadsheet in the same format as AIA G703 for each Owner Allowance.
   01 Provide a separate supplemental spreadsheet for each Allowance included in the Contract.
   02 Supplemental allowance spreadsheets shall include Columns A through I as described on AIA G703.

C. Each allowance expenditure authorization (AEA) shall be listed separately with the authorized / scheduled value identified in Column "C".
   01 Each item (CPR) included in the AEA shall be listed separately for each AEA, with scheduled value included for each item.

D. Progress on each AEA item shall be tracked on the supplemental spreadsheet (i.e. previously billed, work this period, overall completion percentage, etc.).

E. The Master Application for Payment shall include ONLY totals from each Allowance supplemental spreadsheet for each application period.

PART 3 - EXECUTION

3.1 APPLICATION FOR PAYMENT

A. General provisions for submitting, approving and processing Applications for Payment is described in the Owner-Contract Agreement, General Conditions and / or Supplementary Condition. In addition to these provisions, the following provisions will also be required.

B. Once line-item scheduled values (Column C) have been approved by the Architect, those values ***must remain constant without revision throughout the construction phase***.
   01 Exception: The only exception to modifications of Column C shall be properly executed Change Orders which affect the Contract amount.
   02 The amount of the Change Order shall be reflected in an added line item at the end of the Application for Payment.

C. Preliminary Draft:
   01 The Contractor shall provide a draft of their proposed Application of Payment (the Draft), including supplemental Owner allowance sheets, for each pay period to the Architect's Field Representative.
   02 The Draft shall be a copy of the most recent Application for Payment that has been approved (i.e. previous month).
   03 The Draft shall be red-lined / marked with percentages complete in Column G for the current proposed Application for Payment.
   04 The Architect's Field Representative shall review the Draft on-site with the Contractor's selected personnel (i.e. superintendent or project manager).
   05 Any revisions to the Draft shall be noted, discussed and agreed upon by both the Contractor and Architect's Field Representative.
   06 Upon agreement of all revisions, both the Contractor and Architect's Field Representative shall initial the front page of the Draft.
   07 The Contractor shall provide a copy of the final, initialed Draft to the Architect's Field Representative for record.

D. Application for Payment:
   01 The Contractor's submitted Application for Payment for approval shall reflect all percentages complete, including revisions, agreed upon by the Contractor and Architect's Field Representative.
   02 The Application for Payment shall include an attached copy of the final, initialed Draft.
   03 The Application for Payment shall include Allowance supplementary spreadsheets.

E. Applications for Payment which do not include the above requirements shall be rejected and returned to the Contractor without processing.

F. The General Contractor will be responsible to enter the Application on the Owners Project Management Software (Projectmates)

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT SOFTWARE

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. This Section specifies administrative and procedural requirements necessary for project management utilizing on-line project management software.
   01 Owner designated project management software – Projectmates.

C. Related Work:
   01 Section 01 31 13 – Project Coordination
   02 Sections 01 29 76 – Progress Payment Procedures
   03 Section 01 33 00 – Submittal Procedures
   04 Section 01 77 00 – Close-Out Procedures

1.2 QUALITY ASSURANCE

A. The Owner shall provide live training and / or tutorial training videos to key Contractor personnel, including but not limited to:
   01 Project manager and assistant project managers as applicable
   02 Project superintendent and assistant superintendents as applicable
   03 Administrative support staff
   04 Others as requested by the Contractor or Architect

B. The Contractor shall designate one member of his project team that will be responsible for assuring proper, timely and continuous usage of the project management software throughout the duration of the project.
   01 Contractor’s personnel shall become proficient in the use of the software.

C. Contractor shall ensure usage of the project management software throughout the project.
   01 In the event any Contractor key personnel are replaced or new key personnel are brought into the project team, the Contractor shall ensure the replacement personnel are trained and become proficient in the use of project management software.

PART 2 - PROJECT MANAGEMENT ELEMENTS

2.1 SUBMITTALS

A. Refer to section 01 33 00 – Submittal Procedures for specific information regarding the requirements for submittals.

B. All submittals shall be submitted in electronic format except physical samples and mock-ups, unless otherwise agreed to by the Architect.

2.2 REQUEST FOR INFORMATION - RFI

A. An RFI shall be submitted by the Contractor to the Architect to obtain project information where pertinent information is not readily identifiable in the Contract Documents.

B. The Contractor is not limited on the reason for submitting and RFI; however, the Contractor shall perform a thorough review of the Contracts Documents to assure the needed information is not already included in the Contract Documents.

C. Where there are discrepancies between different parts of the Contract Documents, the Contractor is required to submit an RFI for clarification prior to proceeding.
   01 The Contractor assumes full responsibility of the work – acceptable or not acceptable – if he proceeds without submitting an RFI.
   02 Note: In cases of discrepancy the General Conditions of the Contract require the Contractor and subcontractors to base their proposal on the most quantity and / or best quality, as applicable.

D. Whenever possible, for each RFI, the Contractor shall provide a suggested / recommended answer or solution to the RFI.

PART 3 – EXECUTION

3.1 PROJECT MANAGEMENT PROCESSES

A. The following elements of the project shall be generated, communicated, and managed through the Owner's project management software:
   01 Submittal processing.
   02 Request for information (RFI) processing.
   03 Architect's Supplemental instructions (ASI) processing
   04 Change proposal request (CPR) processing
   05 Allowance expenditure authorization (AEA) processing
   06 Punch list processing
   07 Warranty processing

B. Contractor Initiated Elements: The Contractor shall initiate processing of the following elements:
   01 Submittal processing.
   02 Request for information (RFI) processing.

C. Architect Initiated Elements: The Architect shall initiate processing of the following elements:
   01 Architect's Supplemental instructions (ASI) processing
   02 Change proposal request (CPR) processing
   03 Allowance expenditure authorization (AEA) processing
   04 Punch list processing
   05 Warranty processing

3.2 SUBMITTAL PROCESSING

A. The Contractor shall initiate transmission of all submittals through the project management software.
   01 Refer to section 01 33 00 – Submittal Procedures for required submittal numbering, grouping and Contractor review.

B. Distribution lists for submittals shall be as agreed upon by the Architect and Contractor, which shall vary depending on the specific submittal subject.
   01 Coordinate with Architect to develop distribution lists prior to the start of the submittal process.

C. The Architect shall be responsible for transmitting all reviewed submittals, including consultant submittals, back to the Contractor.
   01 The project management software will auto-generate an email notification to the Contractor that the submittal response / review is complete and available.
   02 The email shall include a link to the submittal response / review.

3.3 RFI PROCESSING

A. The Contractor shall initiate transmission of all RFI's through the project management software.

B. RFI numbering shall be sequential.

C. The contractor shall fill out the following fields:
   01 RFI subject
   02 RFI recipient, which shall be the Architect's designated recipient for RFI's
   03 Other recipients to be copied on the RFI.

D. There are two options available to convey the text of the RFI:
   01 Type the RFI and proposed solution directly into the relative fields on the project management software RFI page. Any supplementary documents may be attached / uploaded on the RFI page.
   02 Attach / upload the RFI and proposed solution using the Contractors standard RFI form directly on the project management software page.
   03 If option 2 is utilized, the RFI number on the Contractor's attached RFI form must match the RFI number created.

E. RFI responses from the A/E recipient shall be returned to the Contractor through the project management software.
   01 The project management software will auto-generate an email notification to the Contractor that the RFI response is complete and available.
   02 The email shall include a link to the RFI response.

3.4 ASI PROCESSING

A. The Architect shall initiate transmission of ASI's to the Contractor through the project management software.

B. ASI numbering will be auto generated by the architect.

C. Similar to RFI's, the ASI may be written directly on the project management software page, and / or included as an attachment.

D. The project management software will auto-generate an email notification to the Contractor that the ASI has been transmitted.

E. Once an ASI is received by the Contractor, no further administrative action is required by the Contractor, with the following exception:
   01 If the Contractor believes a directive given in an ASI should result in additional cost or contract time, the Contractor shall have a maximum of seven (7) calendar days to notify the Architect.
   02 Failure of such notification shall represent the Contractor's agreement that the ASI directive(s) do not result in additional cost or additional time.

3.5 CPR PROCESSING

A. The Architect shall initiate transmission of CPR's to the Contractor through the project management software.

B. CPR numbering will be auto generated by the project management software.

C. The project management software will auto-generate an email notification to the Contractor that the CPR has been transmitted.

D. Contractor CPR Response: The Contractor shall provide a response to each CPR that includes, but is not limited to the following:
   01 Cover letter identifying the CPR and subject, including the net overall cost or credit of the CPR.
   02 Summary sheet of material and labor of relative work to be self-performed by the Contractor.
   03 Summary sheet for total expense / credit from each involved subcontractor to include:
      a. An itemized list of materials with itemized costs and shipping costs as applicable.
      b. Personnel, labor rates and total labor for each category
      c. Equipment costs
      d. Markup(s) as allowed by the Contract.
      e. Summary of all costs
   04 All subcontractor pricing documents substantiating their pricing.
   05 Copy of the original CPR.

E. Prior to submitting a CPR response to the Architect, the Contractor shall thoroughly review all submitted subcontractor back-up.
   01 Confirm scope of work is complete and accurate.
   02 Confirm reasonableness of all material and labor costs.
   03 Confirm markup(s) are in accordance with Contract allowances.

3.6 AEA PROCESSING

A. The Architect shall initiate transmission of AEA's to the Contractor through the project management software.

B. Upon receipt, the Contractor shall affix his signature and date and return to the Architect through the project management software.

C. The Architect shall forward to the Owner for signature and return to the Architect.

D. Once the AEA has been fully executed, the Architect shall distribute to the Contractor and Owner.
   01 The final, executed AEA shall have all relative CPR's attached for record.

3.7 PUNCH LIST PROCESSING

A. Refer to section 01 77 00 – Close-Out Procedures for additional punch list requirements.

B. All punch lists shall be completed using Plans App, an application to describe punch list items with the ability to utilize floor plan and photo inserts to better delineate the punch list item.
   01 Plans App is a free app to be downloaded to an iPad or similar device.
   02 The Architect shall provide training to the Contractor for using Plans App.

C. The information to be filled in includes the following:
   01 Item Number: auto assigned by Plans App
   02 Contract Document Room Number
   03 Building Room Number
   04 Walk-Thru Date
   05 Author
   06 Item Category: obtained from a drop down menu
   07 Item Description: obtained from a drop down menu
   08 Comments
   09 GC Completion Sign-Off
   10 Architect Sign-Off
   11 Floor Plan Insert (Option to turn off where not necessary)
   12 Photo Insert (Option to use or not use as needed)

D. Upon receipt of the Contractor's punch list, the Architect shall provide supplementation using the Plans App software application.

E. Implementing Correction of Punch List Items:
   01 The Contractor shall take action to address all punch list items.
   02 Upon confirming the item has been correctly and completely addressed, the Contractor shall:
      a. Designate such by filling in GC Sign-Off field
      b. Provide photographic documentation of the correction directly into the Plans App software.

F. Upon delivery of the completed punch list, the Architect (or consultant) shall back check the punch to verify the item has been satisfactorily addressed.
   01 It shall be the Architect's sole discretion to back-check partially completed punch lists.

3.8 WARRANTY PROCESSING

A. Upon receiving warranty information from the Owner, the Architect shall vet the item to determine it is or is not a warranty item covered under the Contractor's contractual warranty.

B. If legitimate, the warranty shall be processed using the project management software.

C. The Contractor shall receive notification of the warranty item by email, at which point he shall view the warranty item on the project management software.

D. The Contractor shall address all warranty items using his own personnel or by assignment to the responsible subcontractor.

E. Wherever possible, all warranty items shall be addressed within a seven (7) day period; and where not possible, the Contractor shall advise the Architect:
   01 Of why the item shall require more time, and
   02 The anticipated correction completion date for the item.

F. Upon completion, the Contractor shall designate such through the project management software.
   01 Where appropriate, the Contractor shall upload photo documentation of the completed warranty work.

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
This Section specifies administrative and procedural requirements necessary for coordinating Work operations including, but not limited to, the following:
01 General coordination procedures
02 Coordination CAD Drawings
03 Coordination Revit models

C. Related Work:
01 Section 01 32 16 – Construction Progress Schedule
02 Section 04 20 00 – Unit Masonry
03 Section 05 12 00 – Structural Steel Framing
04 Section 05 41 00 – Structural Metal Stud Framing
05 Section 09 21 16 – Gypsum Board Assemblies
06 Section 09 51 13 – Acoustical Tile Ceilings
07 Division 21 – Fire Protection
08 Division 22 – Plumbing
09 Division 23 – HVAC
10 Division 26 – Electrical

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Submit two (2) copies of all AutoCAD Coordination Drawings printed on 30” x 42” format sheets; and additionally, one (1) electronic copy of all Coordination Drawings.
01 A/E team shall provide AutoCAD files to the Contractor for use in developing Coordination Drawings.

C. Submit an electronic Revit (model) file containing all proposed work requiring coordination; and additionally, 2 copies printed on 30” x 42” format sheets; and additionally, one (1) electronic copy of all Coordination Drawings.
01 A/E team shall provide Revit files to the Contractor for use in developing coordination models.

D. Submission and resubmission of Coordination Drawings / Models shall continue until all conflicts have been fully resolved and agreed upon by Architect, Contractor and Owner.
01 AutoCAD: Upon resolution of all conflicts, submit two (2) copies of final Coordination Drawings, and, one (1) electronic copy of all Coordination

Drawings in AutoCAD format for implementation of the Work.

02 Revit: Upon resolution of all conflicts, submit one (1) electronic Revit (model) file; and two (2) copies of final Coordination Drawings in PDF format.

E. Contractor shall maintain copies of all Coordination Drawings at the project site; and distribute copies to subcontractors as required to assure adherence to the conflict-free Drawings.

F. Submittal Coordination: Contractor shall devise a process for each subcontractor to use to clearly identify his work, including the ability to isolate a particular subcontractor's work.

01 For printing purposes, assign a color code each subcontractor.

02 Electronically for AutoCAD or Revit, assign a separate layer for each subcontractor.

1.3 QUALITY ASSURANCE

A. Coordination Drawings shall be based on field measurements, submittals, Shop Drawings and product data proposed to be furnished.

B. Coordination Drawings shall be comprised of plans, sections and elevations as required to accurately depict proposed installation of interfacing and adjacent installations and assemblies.

C. Coordination Models shall be comprised of all components required to accurately depict proposed installation of interfacing and adjacent installations and assemblies.

D. Coordination Drawings / Models shall be prepared early enough in the construction process to allow time for review, and to identify and resolve conflicts without delaying the progress of the Work.

E. Contractor's untimely submission of Coordination Drawings which result in subsequent conflicts that could have been averted by timely submission shall result in the Contractor's responsibility to bear the cost(s) to remedy the conflict(s).

PART 2 - PRODUCTS

2.1 COORDINATION DRAWINGS

A. Plan Views: Coordination Drawings shall be submitted in plan form with sufficient detail to fully describe the Work, and shall include, but not be limited to:

01 Structural steel framing
02 Mechanical ductwork
03 Fire sprinkler piping
04 Plumbing - roof and secondary drains
05 Partitions
06 Ceiling fur-downs

B. Elevation / Sectional Views: Coordination Drawings for mechanical rooms and central plant shall include elevation and sections through proposed work in addition to plan views; and shall include, but not limited to:

01 Structural elements
02 Masonry
03 Partition framing

04 HVAC equipment
05 Ductwork – supplies and returns
06 Electrical gear (panelboards and transformers)
07 Other major components as required to confirm coordination of assemblies.

C. Shop Drawings shall depict actual proposed project conditions related to each assembly.

D. All dimensions indicated on the Drawings are based on the specific models and manufacturers of products, equipment, fixtures and miscellaneous items specified or used as a design basis.
01 If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these Specifications, the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings and miscellaneous items – all subject to approval by the Architect.
02 When dimensional changes are required in these situations, the Contractor shall submit a proposed Modification Drawing to the Architect for approval prior to proceeding with the Work. All causes and effects of the dimensional change shall be indicated on the Contractor's Drawing submittal.

2.2 COORDINATION MODEL

A. Coordination models in Revit shall be complete to the point that all elements required for coordination are accurately depicted; and shall include, but not be limited to:
01 Structural steel framing
02 Mechanical ductwork
03 Fire sprinkler piping
04 Plumbing - roof and secondary drains
05 Partitions
06 Ceiling fur-downs
07 Ceiling planes

B. Prior to the coordination meeting, the Contractor shall run the model through conflict resolution software (i.e., Navis Works, or similar) to identify all conflicts in the model.
01 Provide the conflict report generated by the conflict resolution software at the review meeting(s).

C. All dimensions indicated on the Drawings or included on A/E Revit models are based on the specific models and manufacturers of products, equipment, fixtures, and miscellaneous items specified or used as a design basis.
01 If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these Specifications, the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings, and miscellaneous items – all subject to approval by the Architect.
02 When dimensional changes are required in these situations, the Contractor shall submit a proposed Modification Drawing to the Architect for approval prior to proceeding with the Work. All causes and effects of the dimensional change shall be indicated on the Contractor's Drawing submittal.

PART 3 – EXECUTION

3.1 COORDINATION - GENERAL

A. Contractor shall coordinate operations included in various Sections of Contract Documents to assure efficient and orderly installation of each part of Work. Coordinate Work operations included under related Sections of Contract Documents that depend on each other for proper installation, connection, and operation of Work, including but not limited to:

01 Schedule construction operations in sequence required where installation of one part of Work depends on installation of other components, before or after its own installation.

02 Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

03 Provide provisions to accommodate items scheduled for later installation.

04 Prepare and administer provisions for Coordination Drawings.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of Work. Such administrative activities include, but are not limited to, following:

01 Preparation of schedules.

02 Installation, relocation, and removal of temporary facilities.

03 Delivery and processing of submittals.

04 Progress meetings.

05 Project closeout activities.

C. Contractor will be responsible for the overall coordination review. As each Coordination Drawing is completed, Contractor will meet with Owner to review and resolve all conflicts on Coordination Drawings.

D. Coordination meetings will be held in Project field office of Contractor. Contractor is required to distribute Shop Drawings, cut sheets and submittals to subcontractors where appropriate. Reviewed Coordination Drawings will be maintained in Project field office of Contractor. Meeting minutes shall be developed by Contractor and submitted to Owner and Architect within five (5) days.

E. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, product data, samples or similar submittals until the respective submittal has been reviewed by the Architect / Consultant without request for re-submittal.

3.2 SCHEDULE

A. The Contractor shall schedule to complete the Coordination Drawing / model submittal process prior to completion of submittal review of any trades, components or assemblies included in the Coordination Drawings.

B. The Contractor shall formulate and provide a submittal schedule to the Architect within twenty (20) days after execution of the Owner – Contractor Agreement, to allow for proper coordination and scheduling reviews.

C. In formulating the Coordination Drawing schedule, the Contractor shall allow the following review periods for Coordination Drawings:
   01 Architect – allow fourteen (14) calendar days response time, after Architect's receipt, for all submittals made to and reviewed by the Architect.
   02 Architect's Consultant – Allow twenty (20) calendar days response time, after Consultant's receipt, for all submittals which must be reviewed by Architect's Consultants.
   03 All Consultant submittals shall be returned to the Architect for delivery to the Contractor.

D. In formulating the coordination Revit model schedule, the Contractor shall allow the following review periods for Coordination Drawings:
   01 Review shall be electronically by the Contractor, subcontractors, Architect, Consultants and Owner.
   02 Contractor shall schedule review meeting(s).
   03 Allow an appropriate time period of meetings to thoroughly review identified conflicts and get consensus of the conflict resolution by all parties.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Contractor participation in preconstruction conference.
   02 Contractor administration of pre-installation conferences.
   03 Contractor administration of progress meetings

C. Related Work:
   01 Section 01 31 13 – Project Coordination
   02 Section 01 31 29 – Notification of Architect Requirements

1.2 PRECONSTRUCTION CONFERENCE

A. Architect will administer preconstruction conference prior to the Contractor's mobilization on site.

B. Agenda of the preconstruction conference shall include, but not limited to:
   01 Introduction of project teams for Contractor, Architect, Program Manager and Owner.
   02 Contractor's submission of bonds and insurance certificates, if not already submitted.
   03 Review communication protocols.
   04 Review responsibilities of Contractor, Architect, Program Manager and Owner.
   05 Establish day and time for weekly Owner site meetings.
   06 Review Contractor's proposed schedule.
   07 Review and agree upon Contractor's site mobilization and location of job-site trailer.

1.3 PRE-INSTALLATION CONFERENCES

A. Contractor shall convene pre-installation conferences with each sub-contractor prior to commencing work of the sub-contractor.
   01 Contractor shall record attendance on a sign-in sheet.
   02 Contractor shall keep minutes of the conference and distribute to all attending parties prior to the start of the Work.

B. The purpose of the meeting is to fully review subcontractor's work to assure initial installation will be in accordance with the Contract Documents.

C. The agenda shall include, but not limited to the following:
   01 Review the contract documents, including any changes thereto.
   02 Review all RFI's that may affect the Work.
   03 Review the final reviewed submittals, including AE and Contractor comments.
   04 Review conditions of installation, preparation and installation procedures.
   05 Review coordination with related / interfacing work.
   06 It is the responsibility of the Contractor / sub-contractor to resolve all unknown issues, unclear issues, coordination issues, and assembly interface issues in order to comply with the requirements of the Contract Documents.

D. Require attendance includes, but is not limited to the following:
   01 Contractor's superintendent
   02 Architect's Field Representative
   03 Relative sub-contractor
   04 Other sub-contractors whose work may be affected by the relative sub-contractor.

E. Pre-installation conferences shall be scheduled a minimum of forty-eight (48) hours in advance of the start of relative work unless otherwise agreed to by all parties.

F. Pre-installation conferences may be scheduled with multiple sub-contractors at the same time to facilitate awareness of related work. Coordinate with Architect's Field Representative.

G. The Contractor shall keep meeting minutes and distribute to all attendees within three (3) days after the meeting; or sooner if required to facilitate project scheduling.

1.4 PROGRESS MEETINGS

A. Contractor shall schedule and administer all project meetings after mobilization conference throughout progress of the Work at bi-weekly intervals, plus any special called meetings, and all pre-installation conferences.

B. Contractor shall make physical arrangements for meetings, preside at meetings, record minutes, and distribute copies of minutes within two (2) days to attendees, and those affected by decisions made at meetings.

C. Required Attendance:
   01 Contractor's Superintendent
   02 Contractor's Project Manager
   03 Architect's Project Manager
   04 Architect's Field Representative
   05 Architect's Consultants as appropriate to agenda topics for each meeting.
   06 Owner's Representative(s).

D. The primary purpose of the weekly progress meetings is to update the Owner of the project status, progress, schedule and outstanding issues. It shall not be a venue for resolving issues that can otherwise be resolved between the Contractor and Architect / Consultants; unless direct input from the Owner is required.
   01 In as much as practical, meetings shall be scheduled on the same day and time each week. Changes in the normal schedule must be agreed to by all parties.

E. Agenda: The agenda for progress meetings shall include, but not be limited to:
   01 Review work completed since the previous meeting.
   02 Review the Contractor's two-week look ahead schedule.
   03 Review status of progress schedule and adjustments thereto, and delivery schedules.
   04 Review submittal log,
   05 Review RFI log.
   06 Review change proposal log, minor changes and other adjustments to the Work
   07 Review pending changes and substitutions.
   08 Review A/E construction observation reports and resolutions to outstanding issues
   09 Review as-built documents and close-out progress,
   10 Discuss other items affecting progress of work.
   11 New business

1.5 PROGRESS MEETING MINUTES

A. Meeting minutes shall be produced in a form acceptable to the Architect.
   01 Contractor shall submit a sample meeting minutes format to the Architect for review and acceptance prior to the first meeting.

B. Progress meeting minutes shall be kept and furnished by the Contractor and shall be structured to identify all discussion topics, action items and responsible party for action items.
   01 A topic discussed that requires an action shall be identified by the date of the initiating meeting, the agreed upon due date of response and the party responsible for the action.

C. Each meeting with unresolved information or pending action items shall remain on the meeting minutes through one meeting beyond resolution or completion of the pending action of the item, where the item can be reviewed one more time and all parties agree the item can be closed and removed from the meeting minutes.

D. The last meeting shown on the meeting minutes shall relate to the most recent meeting held and shall include all topics of discussion at that meeting.

E. The Contractor shall distribute meeting minutes to the Owner, Program Manager and Architect within three (3) days after the meeting and additionally, paper copies of the previous meeting minutes shall be furnished to all attendees at the beginning of each meeting.

END OF SECTION

SECTION 01 31 29

NOTIFICATION OF ARCHITECT REQUIREMENTS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. In general, the Contractor shall notify the Architect and / or Architect's Consultants whenever there is need of clarification of interpretation of the Contract Documents.

C. Additionally, the Contractor shall notify the Architect and / or Architect's Consultants at specific phases of the Work in order to observe work in place or in progress.

D. The Project Superintendent shall notify the Architect's and Consultant's Field Representative on a regular basis of the ongoing Work.

PART 2 - NOTIFICATIONS

2.1 ARCHITECT / CONSULTANT NOTIFICATION

A. The Contractor shall notify the Architect and / or Architect's Consultant a minimum forty-eight (48) hours in advance of certain stages of construction to observe and verify work is being installed in accordance with the Contract Documents.
   01 Notification shall be sent by email or other written means.
   02 For notices less than forty-eight (48) hours in advance, Architect / Consultant shall endeavor to accommodate the request; however, Contractor assumes all responsibility for schedule delays resulting from untimely notification.

B. Notifications to the Architect shall include, but not necessarily be limited to the following:
   01 Mobilization on site.
   02 Start of asbestos abatement
   03 Start of full or partial demolition.
   04 Clearing of site / stripping of topsoil
   05 Placing of each lift of select fill material.
   06 Installation and cover of underground utilities.
   07 Installation of drilled / spread footings.
   08 Excavation / forming of grade beams.
   09 Placing of all concrete
   10 Installation of lightweight insulating concrete
   11 Installation of concrete masonry units.
   12 Installation of masonry veneer
   13 Completion of structural steel erection.
   14 Installation of metal decking.
   15 Installation of dampproofing / air barrier
   16 Installation and concealment of insulation

17 Installation of roofing.
18 Installation and concealment of sheet metal work / flashing
19 Installation of self-adhered sheet flashing.
20 Installation of building and glazing sealants.
21 Installation of hollow metal frames.
22 Installation of exterior glazing framing and glass.
23 Installation of plaster assemblies.
24 Installation of ceiling grid.
25 Installation of each type of finish flooring.
26 Installation of each type of wall finishes.
27 Installation of walkway covers.
28 Installation of Food Service Equipment; also notify Food Service Consultant.

C. In addition to notifying the Architect, the Contractor shall also notify the Civil Engineer prior to the following stages:
01 Installation and cover of underground site utilities.
02 Installation and cover of manholes and other drainage structures.
03 Installation of lift stations.
04 Installation of storm detention ponds / systems.

D. In addition to notifying the Architect, the Contractor shall also notify the Structural Engineer prior to the following stages:
01 Installation of drilled / spread footings
02 Pouring of grade beams
03 Placing of all building slab concrete
04 Start and completion of structural steel framing.

E. In addition to notifying the Architect, the Contractor shall also notify the MEP Engineer prior to the following stages:
01 Installation of underground service ductbank(s)
02 Installation and cover of underground site electrical.
03 Installation and cover of underground building electrical.
04 Installation of ceiling grid and cover-up.
05 Completion of plumbing rough-in.
06 Installation of plumbing fixtures
07 Installation of HVAC equipment
08 Completion of rigid duct installation
09 Completion of electrical rough-in
10 Installation of all electrical fixtures
11 Any and all testing specified for equipment, mechanical, electrical and plumbing systems.
12 Refer to MEP Specifications for additional information and requirements.

F. In addition to the above requirements, Architect and Consultant(s) shall be notified of all equipment testing, startup procedures, and Owner demonstrations / training sessions.

2.2 INCLEMENT WEATHER NOTIFICATION

A. Owner-Contractor Agreement – Substantial Completion based on calendar days: If the project delivery includes time extensions for interruption or delay of Work due to inclement weather, the Contractor shall adhere to the following procedures for consideration of approval of the weather delay time extension requests:
01 Provide email notification to the Architect of each regular workday delay within twenty-four (24) hours of the delay (i.e. following day – latest)

02 Provide email notification to the Architect of any delays resulting from inclement weather on non-workdays or holidays not later than the end of the first subsequent work day.

03 Notifications shall include the type of weather, nominal quantity of rain / wind velocity (as applicable) and description of how the event delayed the project.

04 If a single weather event results in a multiple-day delay, provide notification for each day in accordance with the above procedures.

05 The General / Supplementary Conditions to the Owner-Contractor Agreement requires allowance for average, normal rain days per month which must be accounted for in the Contractor's baseline schedule and / or Proposal calendar days. Provide notifications for all weather event delays, regardless of required rain days included in the Contractor's schedule.

06 Provide a monthly inclement weather summary log with the Application for Payment. The log shall include actual weather delay days for the month, required anticipated weather days and the net add / gain for the month; as well as a cumulative summary of all such reports.

07 Provide a monthly updated schedule with the Application for Payment. The schedule should reflect the weather delay impact on the critical path of the schedule.

B. Owner-Contractor Agreement – Guaranteed Substantial Completion: If the project delivery includes a guaranteed Substantial Completion Date, there is no allowance for Contract Time extension due to inclement weather; however, as a matter of record, the Contractor shall adhere to the following procedures recording the weather-related interruption or delays:

01 Provide email notification to the Architect of each regular workday delay within twenty-four (24) hours of the delay (i.e. following day – latest)

02 Provide email notification to the Architect of any delays resulting from inclement weather on non-workdays or holidays not later than the end of the first subsequent workday.

03 Notifications shall include the type of weather, nominal quantity of rain / wind velocity (as applicable) and description of how the event impacted the project schedule.

04 If a single weather event results in a multiple-day delay, provide notification for each day in accordance with the above procedures.

05 Provide a monthly inclement weather summary log with the Application for Payment. The log shall include actual weather delay days.

06 Provide a monthly updated schedule with the Application for Payment. The schedule should reflect the Contractor's adjustment to the schedule to make up weather delay days which impact the critical path of the schedule.

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Requirements of Contractor to produce and maintain a detailed Critical Path Schedule (CPM) construction schedule throughout the progress of work.
   02 Owner imposed limitations on the construction schedule.

1.2 SUBMITTALS

A. Construction schedules shall be produced using a Critical Path Method, linking associated tasks and their impact on interfacing / subsequent work.
   01 Provide schedule in as much detail as practical to accurately monitor progress of the work and adherence to the schedule.
   02 Provide in both text and graphic formats.

B. Preliminary CPM Construction Schedule: Within two (2) weeks after receipt of Notice to Proceed, submit a preliminary CPM construction schedule for review.

C. Detailed CPM Construction Schedule: Within two (2) weeks after acceptance of the preliminary CPM construction schedule, submit a detailed CPM construction schedule for review.

D. Baseline CPM Construction Schedule: Upon acceptance of the detailed CPM construction schedule, it shall be base-lined and referred to as the Project Schedule; and shall be used for schedule evaluation throughout the progress of the work.

E. An updated CPM schedule shall be submitted with each monthly application for payment.
   01 Approval and process Contractor’s applications for payment shall be contingent on receipt of an accurate updated CPM schedule.

1.3 QUALITY CONTROL AND QUALITY ASSURANCE

A. The Contractor shall develop and maintain a Project Schedule in accordance with the requirements of this Section. The requirement for a Project Schedule is included to:
   01 Ensure adequate planning before and during the execution and progress of the Work in accordance with the allowable number of working days and milestones.

02 Assure coordination and execution of the work among various trades of the Contractor, subcontractors, suppliers, third party utility companies or other related entities that may be involved in the Project.

B. The project schedule shall show the sequence and interdependencies of activities required for complete performance of the work. The Contractor shall be responsible for assuring all work sequences are logical and show a coordinated plan of the work. The project schedule shall employ computerized CPM planning, scheduling and progress reporting of the work as described in this specification. The Contractor shall create and maintain the schedule using project scheduling software approved by the Owner and Architect that utilizes the fundamentals of CPM for scheduling.

C. The Contractor shall designate a schedule representative who shall be responsible for coordinating with the PM during development and maintenance of the Project Schedule.

01 The Contractor's representative shall have the expertise to operate the CPM software and be capable of rapidly evaluating alternate scenarios to optimize management capabilities.

02 The Contractor has the option to utilize qualified outside scheduling consultation for the assistance of developing and maintaining the Project Schedule, however, the use of an outside consultant does not relieve the Contractor of responsibilities for compliance of this specification.

03 The Contractor's schedule representative shall have complete authority to act for the Contractor in fulfilling the schedule requirements of the Contract, and if such authority is interrupted during the Contract, approval shall be obtained in writing by the PM.

D. All activities shall have at least one predecessor and one successor unless approved by the PM. The exceptions are no predecessor is needed for the Notice To Proceed (NTP) milestone and no successor is needed for the Project Completion milestone.

E. With the exception of the specified contract substantial completion milestone, the contractor shall not use any constraints of any type without prior approval of the Owner.

F. The project substantial completion milestone shall be assigned a "Finish on or Before" constraint. The required contract finish date shall be assigned to track project delivery related to contract requirements.

G. Each activity's "Activity ID" and "Activity Description" or "Task Name" shall remain unchanged throughout the duration of the project subsequent the baseline acceptance by the Owner.

H. An activity's "Activity Description" may only be revised to clarify an activity's original scope. If the scope of an activity increases or decreases, a replacement activity shall be created.

I. Owner acceptance shall be obtained prior to making any changes or revisions to an activity's "Activity Description".

1.4 RELIANCE UPON SCHEDULE

A. The construction schedule will be an integral part of the Contract and will establish conditions for various activities and phases of construction.

B. The Owner, Architect and Architect's Consultant shall rely on the schedule to perform related and interfacing activities.

C. Whenever the progress of the Work falls behind two weeks or more, the Contractor shall adjust the schedule accordingly to demonstrate how progress shall be adjusted to get back on the original schedule.

PART 2 - PRODUCTS

2.1 PRELIMINARY CPM CONSTRUCTION SCHEDULE

A. The Preliminary CPM Schedule shall be the basis for the sequence of work during the first ninety (90) calendar days of the Contract while the Project Schedule is being developed, submitted, reviewed, and accepted. The Preliminary CPM Schedule shall be updated monthly. If the acceptance of the Project CPM Schedule extends beyond one month, the Preliminary CPM Schedule shall be updated according to the requirements stated in paragraph 3.03.

B. The Preliminary CPM Schedule shall include:

01 The Procurement activities to be accomplished (either in whole or in part) during the first ninety (90) calendar days of the Contract. The procurement activities shall include mobilization, shop drawing submittal, sample submittal, Architect / Engineer review and approval period, material fabrication and delivery of key and long-lead items. If portable swing space buildings are required for a project, the preliminary CPM schedule shall include milestones for relocation and installation of such swing space buildings.

02 The construction activities to be a ccomplished (either in whole or in part) during the first ninety (90) days of the Contract. These activities shall be in units of whole working days.

03 The approach to scheduling the remaining work or phases of work beyond the first ninety (90) calendar days of the contract. The work for each phase or milestone must be represented by at least one summary activity for each major item of work such that they cumulatively indicate the entire schedule, with critical project milestones. The approximate duration for each summary activity shall include the Contractor's best estimate for the work it represents.

04 Submit a written narrative describing the Contractor's approach to mobilization, procurement, and construction during the first ninety (90) calendar days of the Project. The narrative shall elaborate on the basis for durations, major equipment to be used, and shall identify all major assumptions used to develop and support the schedule. The narrative shall also include the Contractor's description of the critical path work activity as represented in the Preliminary CPM Schedule.

C. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished.

D. Activities shown on the diagram shall include, but not necessarily be limited to:
   01 Project mobilization.
   02 Submittals and approvals of shop drawings and samples.
   03 Phasing of construction.
   04 Procurement of equipment and critical materials.
   05 Fabrication and installation of materials and equipment.
   06 Final clean-up.
   07 Final inspection and testing.

E. Accurately track and incorporate delays caused by inclement weather and factors outside the Contractor's control.

F. Provide updated schedules at each regularly scheduled site progress meeting.

2.2 PROJECT CPM SCHEDULE

A. The Project Schedule shall begin at the project NTP and incorporate the accepted Preliminary.
   01 CPM Schedule including all required revisions and applicable progress updating as warranted.
   02 The Project Schedule shall indicate a logical sequence of work for each project site (school) and major restrictions from the availability and use of manpower, material and equipment.
   03 Utilize the schedule in planning, scheduling, coordinating and performing the work under this Contract (including all activities of subcontractors, equipment vendors and suppliers).
   04 The Project Schedule shall indicate the sequence and interdependencies of activities required for complete performance of the Work.

B. Proposed durations assigned to each activity shall be the Contractor's best estimate of time required to complete the activity in workdays considering the scope and resources planned for the activity.
   01 In developing the Project Schedule, the Contractor shall be responsible for ensuring that subcontractor work scope and sequencing at all tiers, as well as its own work, is included.
   02 If a contract for a subcontractor has not yet been awarded for a certain portion of the work, the Contractor is responsible for the development of the schedule for the work as described under this section.
   03 After the subcontractor award of contract, the Contractor shall modify the current accepted schedule to reflect any changes or revisions for the subcontractor sequence of work.
   04 Under no circumstance or event, shall a schedule modification or revision under this paragraph extend a milestone.
   05 The Project Schedule shall comply with the various limits imposed by the scope of work and by any contractually specified intermediate milestone dates and completion dates.
   06 The degree of detail shall be to the satisfaction of the PM the A/E or the Owner.

C. Provide sufficient detail and clarity of form and technique so that all work can be properly controlled, and progress monitored by the PM and A/E. The Project Schedule shall consist of, but not be limited to, the following criteria:

01 Full detail of all major procurement activities including the activities and information contained within the Preliminary CPM Schedule. Break up all procurement activities for major components and long lead items to include submittal dates, fabrication duration, and expected delivery dates.

02 Full detail of all major construction activities including the activities and information contained within the Preliminary CPM Schedule. Add column for responsible party (i.e. owner, subcontractor trade, 3rd party, etc.) for all construction activities.

03 Multiple Calendars shall be used for establishing Holidays and periods of non-work based on the School Operations Parameter Statement in the Project Information Section of Division 0, concrete curing activities, other weather, or ambient temperature sensitive construction activities, and or other work requiring overtime or double shift work.

04 Seasonal weather conditions shall be considered and included in the planning and scheduling of all work influenced by high or low ambient temperatures, precipitation and/or saturated soil to ensure recognition, planning and anticipation of intermittent inclement weather throughout the project duration. In addition, activities of similar nature shall be assigned to independent calendars based on this weather data. Contractor to provide a Weather Log each month as part of their Schedule Submittal.

05 Activity duration in whole working days with a maximum duration of ten (10) working days each, unless otherwise approved by the PM, except for non-construction activities including mobilization, procurement, and concrete curing activities.

06 For projects where hazardous materials are present and require abatement by the Owner, such abatement activities may take place prior to the Contractor's mobilization and start of any work, or they may take place concurrently with the Contractor's work. In cases where abatement activities must take place concurrently with Contractor's work, the Contractor shall allow for these activities to be incorporated into the Project CPM Schedule as separate activity line items. The Contractor shall allow time for these activities to take place at the appropriate time within the project schedule and shall coordinate their work with such abatement activities.

07 At a minimum, the following guidelines, intermediate and final milestones shall be included in the project schedules for each individual project site (school), except for activities that are specifically identified to be common for all the project sites for a multi-project bundle:

a. Notice to Proceed
b. Required Periodic Inspections (examples: rebar, utilities, electrical and mechanical rough-in, overhead and architectural
c. Time allotted for coordination with and execution of abatement activities
d. Specific Phase start and finish dates – renovations and additions
e. Preliminary CPM Schedule submission and acceptance
f. Project Schedule submission and acceptance
g. Building dry-in
h. Permanent power
i. Conditioned air available

j. Completed testing and acceptance of Life Safety Systems and other critical building components
k. Completion of ADA upgrades in restrooms
l. Commissioning, when project requires
m. Ten percent (10%) minimum float for the project
n. Substantial Completion
o. Final Completion
p. Owner Turn-Over / Start-Up / Project Closeout Activity / Warranty Period / Owner Testing/Training
q. Earliest Date that Owner can occupy the affected portion of the building (by phase, by complete project, etc.). This shall include all necessary approvals, permits (Fire Marshall Acceptance, Certificate of Occupancy, etc.).

D. Deliverable: Within thirty (30) calendar days after the Notice to Proceed, the Detailed CPM Schedule deliverable submitted by the Contractor shall include at a minimum, the following information:
01 Two (2) copies (preferably 8 ½ x 11) of the project schedule. The critical path shall be readily discernible in red ink.
02 Two (2) copies of the written narrative as described in paragraph 3.01, B.5
03 One (1) electronic copy (accessible format not pdf)
04 A list of all rain days occurring over the past month. Each rain day shall be identified in the Weather Log.

2.3 SCHEDULE UPDATES

A. After the Project Schedule is accepted by the PM and the Contractor, it shall be "baselined" and used as a comparison for future progress updates.
01 The accepted Project Schedule shall be updated on a monthly basis, or as directed by the Owner, throughout the duration of the work until final completion is met.
02 The Contractor shall meet with the PM each month at a Project Progress Meeting to review the work progress update and PM comments regarding the Project Schedule update.
03 The Contractor shall submit a schedule update no later than three (3) working days before the Project Progress Meeting for the PM to review and comment.

B. Out-of-Sequence progress logic shall be reviewed by the contractor's scheduler and corrected before submitting the progress update.

C. The percentage of all work shall be calculated by estimating the actual remaining duration of each progressed activity. The data date of each schedule update shall be determined by the PM each month. Contractor prepared estimates of the percent completion of each scheduled activity and the necessary supporting data shall be submitted on or before the data date referenced above and shall include the following information:
01 One (1) original of the previous month's Schedule Update indicating actual activity start and/or finish dates to date, and revised (current) remaining durations.
02 A narrative report shall be included that indicates in writing those activities the Contractor plans to work on during the following update month and current or anticipated conditions that have delayed or may delay the work in order to discuss remedial action.

03 The Contractor shall also explain, for work that reflects less than satisfactory progress, whether any uncompleted and/or upcoming work will (or will not) be affected in a like manner and the Contractors method of correction.

04 Any additional written information necessary to support the updated schedule including explanations of revisions to activities: logic, durations, resources, etc.

D. In case of disagreements at the project progress meeting concerning actual progress to date, the Owner's determination shall govern. Upon completion of the schedule update meeting, the Contractor shall revise the Schedule Update to reflect progress as of the date of the schedule update meeting and any approved revisions to the Schedule Update and carry out a computer produced calculation to determine the status of the Project Schedule.

E. Each Schedule Update shall be forwarded to the PM within seven (7) calendar days after the schedule update meeting and shall include two (2) copies of the narrative report with the following information:

01 Activities that have been added in the month of this Project Schedule Update.

02 Activities that have been deleted in the month of this Project Schedule Update.

03 Activities that have "Actual Starts" prior to the month of this Project Schedule Update and remain unfinished.

04 Activities that have "Actual Starts and Actual Finishes" in the month of this Project Schedule Update.

05 A description of any approved revisions to the activity descriptions, schedule logic, or initial activity durations.

06 One (1) print of the updated CPM Schedule Update indicating the progress made up to the date of the schedule update and indication of any revisions to the CPM Schedule Update.

07 Two (2) prints of the written narrative as described in paragraph 3.03, B.3.

08 A list of all rain days occurring over the past month. Each rain day shall be incorporated into the Project Schedule Calendar.

F. If the Contractor's monthly progress schedule update reflects, or PM determines, that the Contractor is at least ten percent (10%) or at least negative seven (-7) calendar days behind the "baselined" schedule, the Contractor shall provide a revised or recovery schedule.

01 The Contractor's revised or recovery schedule must incorporate a proposed plan for bringing the work back on schedule and completing the work by the contract completion date at no additional expense to the PM or Owner.

02 A narrative indicating the revised approach to schedule recovery is to accompany the recovery schedule submittal. The revised or recovery schedule shall be in accordance to paragraph 2.08.

2.4 PROJECT FLOAT TIME

A. Float time is not for the exclusive use or benefit of either the Contractor or the Owner. Contractor's work shall proceed according to early start dates, and the Owner shall have the right to reserve and apportion float time according to the needs of the Project.

B. The Contractor acknowledges and agrees that actual delays, affecting paths of activities containing float time, will not have any affect upon contract completion times, providing that the actual delay does not exceed the float time associated with those activities.

PART 3 - EXECUTION

3.1 RELIANCE ON SCHEDULE

A. The Architect and Owner shall rely on the Contractor's CPM schedule with respect to work progress and projected schedules for critical path work.

B. An updated CPM schedule shall be submitted with each monthly application for payment.
   01 Approval and process Contractor's applications for payment shall be contingent on receipt of an accurate updated CPM schedule.

3.2 CONSTRUCTION SCHEDULE LIMITATIONS

A. Work performed under this Contract shall be performed in accordance with the following paragraphs so that the Owner can accept the project as substantially complete as noted below.

B. When the Owner-Contractor Agreement stipulates a guaranteed completion date, the Contractor shall use all means necessary to assure adequate progress of the Work to achieve the contracted Substantial Completion date.
   01 Refer to section 01 23 00 – Alternates for modifications and revisions to provisions of the General Conditions regarding a guaranteed substantial completion date.
   02 Time extensions will only be considered for Owner requested changes that directly impact the critical path of the schedule.

3.3 OWNER CHANGES IN THE WORK

A. The Contractor shall evaluate Owner requested change in the work with respect to impact, if any, to the critical path of the schedule.

B. Responses to Owner requested changes, CPR's and similar documents shall include a full description of schedule impact, if any.
   01 For changes the Contractor believes will affect the critical path of the schedule, provide a revised CPM schedule, or portion thereof that clearly delineates the impact.
   02 Architect and Owner shall evaluate schedule impacts and such information may be a criterion for approval to move forward with the change, or not.
   03 Owner approved changes that do not affect the critical path of the schedule shall be added scope of work the Contractor shall incorporate into the CPM schedule without change of completion date(s).

END OF SECTION

SECTION 01 32 23

SURVEY AND LAYOUT DATA

PART 1 G E N E R A L

1.01 QUALITY CONTROL

A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Owner's Representative if required by the Contract.

1.02 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit the name, address, and telephone number of Surveyor to Owner's Representative before starting survey work.

C. Submit documentation verifying accuracy of survey work on request.

D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

1.03 PROJECT RECORD DOCUMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.

C. Submit record documents under provisions of Division 1.

1.04 EXAMINATION

A. Verify locations of survey control points prior to starting the Work.

B. Notify the Owner's Representative immediately if any discrepancies are discovered.

1.05 SURVEY REFERENCE POINTS

A. The Owner will establish survey control datum as indicated on Drawings. Inform Owner's Representative in advance of time additional horizontal and vertical control points will be established so verification deemed necessary by Owner's Representative may be done with minimum inconvenience to the Owner or Contractor.

B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.

C. Notify the Owner's Representative a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.

D. Promptly report loss or destruction of reference points to Owner's Representative.

E. Reimburse the Owner for cost of reestablishment of permanent reference points disturbed by construction operations.

1.06 SURVEY REQUIREMENTS.

A. Utilize recognized engineering survey practices.

B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.

C. Establish elevations, lines and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:

1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs.
2. Grid or axis for structures.
3. Building foundation, column locations, and ground floor elevations.

D. Periodically verify layouts.

PART 2 P R O D U C T S – Not Used

PART 3 E X E C U T I O N – Not Used

END OF SECTION 01 32 23

SECTION 01 33 00

SUBMITTAL PROCEDURES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all submittals required in specific Specifications Sections in strict accordance with the procedures described below.
   02 All submittals shall be processed using the Owner's project management software – Project Mates.

C. Related Work:
   01 Section 01 31 00 – Project Management Software
   02 All Division 2 through Division 32 Specification Sections.

1.2 PROJECT MANAGEMENT SOFTWARE

A. All submittals shall be submitted and processed using Tomball ISD/LAN project management software – Project Mates. The successful proposer will be required to obtain a license for their own copy and/or copies of the software Package.

1.3 QUALITY ASSURANCE

A. It is the sole responsibility of the Contractor / sub-contractor / material supplier to provide materials and Work that conforms to the requirements of the Contract Documents.

B. The function of the submittal process is to provide the Contractor / sub-contractor / material supplier additional review / quality control of the materials / work proposed to be furnished for the Work.

C. Prior to delivery to the Architect or Consultant, each submittal shall be thoroughly reviewed by the party / sub-contractor generating the submittal, as well as the General Contractor.
   01 Each reviewer shall document their review by affixing a stamp and signature, or a signed review cover sheet to each submittal. General Contractor sign-off for the submittal originator is not acceptable.
   02 All corrections shall be clearly noted.
   03 The Contractor shall determine whether the submittals are suitable to forward to the Architect / Consultant or return to the originator for revisions and re-submittal.
   04 Submittals which do not display (at least) two prior, separate reviews (submitter and General Contractor) shall be rejected and returned to the General Contractor.

D. The Architect's / Consultant's review of submittals is only for review of the general conformance with the design concept of the project and general compliance with the information given in the Contract Documents.
   01 The Architect's / Consultant's review of submittals shall NOT be construed as approval of the products, assemblies or Work being submitted, unless specifically stated as such.
   02 The Architect / Consultant shall not field verify any information requested on the submittal. That is the responsibility of the Contractor.

E. Submit only what is proposed to be furnished. Where cut-sheets, etc. also contain information on items not to be furnished, clearly indicate / identify / separate the specific items proposed to be furnished from those which are not proposed to be furnished.
   01 Where no such indication is made, it shall be understood the submittal is presenting options to be selected by the Architect / Consultant at no additional cost to the Owner.

F. Submittals shall be rejected by the Architect / Consultant for any of the following:
   01 Lack of required review stamps / cover sheets.
   02 Apparent / obvious lack of review by the General Contractor or original provider / subcontractor.
   03 An inordinate amount of revisions already noted by the General Contractor / sub-contractor.
   04 Incomplete or missing information.
   05 Inclusion of other items not proposed to be furnished.

G. The Contract Documents in electronic format may be made available to the Contractor / sub-contractor for their use, provided the users execute a release form to the Architect / Consultant. Refer to **Section AI** for applicable forms to be executed and returned the relative party (Architect / Consultant) prior to release of Contract Documents in electronic format.

H. All submittals shall be submitted with a cover sheet containing the following information:
   01 Contractor's submittals number
   02 Date of submission and dates of any previous submissions
   03 Project title and Architect's project number
   04 Relative Specification Section number
   05 Names of Contractor, subcontractor, supplier, and / or manufacturer.
   06 Signed and dated review stamp or comment sheet from the party / sub-contractor generating the submittal
   07 Signed and dated review stamp or comment sheet from the General Contractor

I. For any particular submittal, submit all written, standard format information as a single submittal; including the following as applicable to the submittal:
   01 Product Data
   02 Installation Instructions
   03 Maintenance Instructions
   04 Certificates
   05 Sample Warranties

J. For any particular submittal, submit all required Shop Drawings as a single submittal.

K. For any particular submittal, submit all required product samples as a single submittal.

1.4 ELECTRONIC DELIVERY

A. Electronic delivery of paper submittals in PDF format is required.
   01 Coordinate with the Architect for electronic of hard-copy delivery of full-size Shop Drawings submittals prior to submission.
   02 Provide a single, electronic copy of submittals with all previous review comments / mark-ups the Owner's project management software – ProjectMates
   03 Submittals shall be returned electronically to the General Contractor along with review comment sheets and / or mark-ups.
   04 The Contractor shall be required to print and distribute completed submittals to sub-contractors.

B. Electronic submittals in PDF format shall be made in the same format (size) of the actual submittal (i.e. 8-1/2x11, 11x17, 24x36, and / or 30x42).

C. The following are exceptions to the above and shall be submitted in electronic and hard copy:
   01 Steel Shop Drawings: to be submitted on full size, scalable sheets. Submit the number to be returned plus three (3) copies to be retained by the Architect and consultant.
   02 Bound MEP manuals / submittals in excess of twenty-five (25) pages. Submit the number to be returned plus three (3) copies to be retained by the Architect and Consultant.

D. Owner's Record Set of Submittals:
   01 The Contractor shall maintain a separate set of all final submittals to be delivered to the Owner at project close-out.
   02 Submittals shall be organized, in order, by Specification Section.

1.5 SAMPLE DELIVERY

A. Samples:
   01 Prior to submitting actual samples, deliver all electronic document submittals to the Architect.
   02 Submitted samples shall be the actual material(s) proposed to be furnished.
   03 Colors samples on paper or electronic format shall not be acceptable.

B. Unless otherwise agreed to by the Architect, all sample submittals shall be delivered directly to the Architect's office.

1.6 SUBMITTAL NUMBERING AND NAMING

A. Each submittal shall contain an identification number and specific written title.
   01 Submittals numbers should have a two (2) digit suffix based on Specification Section. (i.e. 04 20 00-01)
   02 Re-submittal numbers shall have an additional two (2) digit suffix based on Specification Section. (i.e. 04 20 00-01**-01** or 04 20 00**-01r01** per individual project settings.)
   03 Any additional GC submittal ID could be entered when sending the submittal to the Architect in the Sender ID field.
   04 Indicate the correct submittal number and description on the cover sheet.

B. Each submittal shall contain a specific written title identifying the content of the submittal.
   01 Documentation Submittal Package:
      a. Product Data
      b. Installation Instructions
      c. Maintenance Instructions
      d. Certificates
      e. Sample Warranties
   02 Shop Drawings Submittal Package:
      a. Shop Drawings
      b. Engineering Calculations
   03 Samples Submittal Package:
      a. Physical Samples (To be stored on site)
   04 O&M Manual Submittal Package (Prior to Substantial Completion:
      a. Review Copy: Hard-copy in 3-ring binder.
      b. Final Copy: Hard-copy in 3-ring binder and electronic copy on flash drive. Verify quantity with Architect.

C. Failure to comply with the all quality assurance requirements may result in immediate rejection of the submittal without review. In such circumstances, no additional time shall be granted to the Contractor for resultant delays.

PART 2 - PRODUCTS

2.1 DOCUMENTATION SUBMITTAL

A. Manufacturer’s Product Data: Submit manufacturer’s complete printed data on each product; including, but not necessarily limited to product cut-sheets, specifications, quality references, MSDS sheets, and general information, as necessary to demonstrate compliance with all specified requirements.

B. Manufacturer's Installation Instructions:
   01 Submit manufacturer’s installation instructions, including all requirements as they specifically relate to the Work required in this Contract.
   02 Submission of generic details that do not depict actual conditions of the project shall be rejected.

C. Manufacturer's Maintenance Instructions: Manufacturer's printed maintenance detailing information for proper care and maintenance of the product or assembly.

D. Manufacturer’s Test Reports and Certifications: Where applicable, submit test reports and certifications demonstrating compliance with the referenced standards and requirements.

E. Warranties in Excess of one (1) Year: Submit sample copy of proposed warranties to be issued and executed for contract close-out.

2.2 SHOP DRAWING SUBMITTAL

A. Shop Drawings shall be submitted with sufficient detail to fully describe the Work included. Partial sets, if submitted without prior approval from the Architect, shall be subject to rejection and / or holding until subsequent shop drawings are submitted.

B. Details included in Shop Drawings shall depict actual project conditions related to the assembly. Details depicting generic substrates or interfacing work shall be subject to rejection.

C. All dimensions indicated on the Drawings are based on the specific models and manufacturers of products, equipment, fixtures and miscellaneous items specified or used as a design basis.
   01 If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these Specifications, the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings and miscellaneous items – all subject to approval by the Architect.
   02 When dimensional changes are required in these situations, the Contractor shall submit a proposed Modification Drawing to the Architect for approval prior to proceeding with the Work. All causes and effects of the dimensional change shall be indicated on the Contractor's Drawing submittal.

D. Where required in individual Specification Sections, provide engineering calculations clearly demonstrating the proposed materials, products and / or assemblies meet or exceed the stated design criteria.
   01 Where required by individual Specification Sections, calculations shall be sealed and signed by a Texas Registered Engineer of appropriate discipline (structural, MEP, etc.) pertinent to the required calculations.

2.3 SAMPLE SUBMITTAL

A. Finish Samples: Submit full range of manufacturer's standard colors, textures, and patterns for Architect's selection.
   01 Prior to submission of samples, provide all relative documentation submittals to the Architect.
   02 At Architect's option sample submittals may be waived if Architect already has samples of proposed materials in the Interiors Library. Coordinate with Architect as required.

B. Selection of finishes from paper or digital representations shall not be accepted. Samples requiring selection of a color, pattern or similar finish shall be submitted in one of the following methods:
   01 Whenever possible, submit actual material product samples (i.e. carpet, aluminum, glass, plastic laminate, sealants, etc.)
   02 Paint colors for pre-finished materials shall be submitted on actual samples of substrate materials (i.e. paint on sheet metal).
   03 Manufacturer's standard color wheels or similar shall be acceptable for paint selections for field painted items; however, the Architect may require to see / approve an actual application of paint on the intended material in the field.

C. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.

D. Submittals shall contain:
   01 Date of submission and dates of any previous submissions
   02 Project title and number
   03 Contract identification
   04 Names of Contractor, Supplier, Manufacturer
   05 Identification of sample, with specification section number

2.4 MOCK-UPS

A. Provide mock-ups of actual products or assemblies where required in individual Specifications.
   01 Coordinate with other trades as required for mock-ups incorporating work from multiple trades.

B. Mock-ups shall specifically represent what is proposed to be furnished in the actual, installed work.

C. Once approved, all mock-ups shall be retained by the Architect and / or be left assembled at the job site until all such Work is completed at the project; and shall become the basis for comparing / accepting actual installed work.

PART 3 – EXECUTION

3.1 PREPARATION

A. The Contractor shall formulate and provide a Preliminary Submittal Log to the Architect within twenty (20) days after execution of the Owner – Contractor Agreement, to allow for proper coordination and scheduling reviews.

B. Preliminary Submittal Log: Prior to submission of any submittals, the Contractor shall furnish a in Excel format a complete spreadsheet of all submittals proposed to be furnished.
   01 The list should be comprehensive and aligned with the CSI specification number identified in the Project Manual.
   02 Additionally, include the anticipated schedule for the submission of each submittal.
   03 The submitted spreadsheet shall include the following Columns:
      a. CSI Specification Number
      b. (Optional) Contractor's Submittal Number (Sender ID)
      c. Submittal Title/Subject
      d. Submittal Description (Shop Dwgs, Product Data, Sample)
      e. Date Submittal is expected to be received
      f. Contact's name sending the submittal

C. Upon receipt, the Architect shall review the preliminary submittal log and coordinate with the Contractor on any revisions.

3.2 SUBMITTAL COORDINATION

A. Where ever possible, individual submittals should consolidate all required submittal information (i.e. product data, installation instructions, maintenance instructions, etc.)
   01 Shop drawings, samples and similar items may be submitted separately; however, they should be submitted at the same time, unless otherwise agreed upon by the Architect.
   02 The submittals for a particular specification or assembly shall not be considered complete and reviewable until all items / information required to be submitted have been received by the Architect.
      a. Exceptions: O&M manuals, final warranties and similar end of construction items.
   03 Review of piecemealed submittals shall be at the Architect's sole discretion; and will only be considered for extraordinary conditions.

B. Group or package submittals relative to the assembly which are dependent upon each other for a thorough review (i.e. doors, frames and hardware).
   01 Time periods for proper and complete submittal reviews which are contingent on or must be coordinated with separate but related submittals shall begin at the time of the Architect's / Consultant's receipt of the last required submittal. Contractors are urged to group submittals appropriately in this regard.

C. Selection of finish samples will begin only after receipt of all finish selection samples, including exterior and interior finishes. Finishes and samples shall NOT be selected piecemeal.

D. No extensions of Contractor Time or Cost shall be allowed due to lack of submittal coordination by the Contractor.

3.3 SCHEDULE

A. The Contractor shall schedule to complete the submittal process within a maximum of one hundred twenty (120) days after execution of the Owner – Contractor Agreement.

B. In formulating the submittal schedule, the Contractor shall allow the following review periods:
   01 Architect – allow fourteen (14) calendar days response time, after Architect's receipt, for all submittals made to and reviewed by the Architect.
   02 Architect's Consultant – Allow twenty (20) calendar days response time, after Consultant's receipt, for all submittals which must be reviewed by Architect's Consultants.
   03 All Consultant submittals shall be returned to the Architect for delivery to the Contractor.

3.4 PROCEDURES

A. All submittal packages shall be transmitted / uploaded to the project management software.

B. Transmit each submittal package with coversheet containing the following information:
   01 Project name
   02 Contractor name
   03 Subcontractor and / or major supplier.
   04 Submittal number.
   05 Specification Section number and name.
   06 Type of submittal package (i.e. documentation, Shop Drawings, etc.)
   07 Subcontractor review / approval certification or stamp.
   08 Contractor review / approval certification or stamp.

C. Sub-Contractor's / Supplier's Conveyance to the General Contractor: Each sub-contractor / supplier is required to review their own submittal; and additionally, apply a signed and dated stamp certifying review, verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the Work and Contract Documents.

D. Contractor's Conveyance to the Architect / Consultant: The Contractor is required to thoroughly review and check all submittals received from subcontractors / suppliers; and additionally apply a signed and dated stamp certifying a thorough review.
   01 The submittal shall contain Contractor review comments and / or mark-ups as applicable.

E. Submittals forwarded to the Architect / Consultant without the Subcontractor's and Contractor's review stamp shall be automatically rejected without review and returned to the Contractor.

F. If, in the opinion of the Architect / Consultant, the submittal indicates a lack of review or the Contractor's / sub-contractor's review is incomplete, the submittal will be returned, unchecked, to the General Contractor for correction of any / all deficiencies for subsequent re-submittal.

G. Revise and resubmit submittal as required; clearly identify all changes made since previous submittal.
   01 Submittals that are required to be resubmitted more than one (1) time shall be subject to additional service charges for the Architect's / Consultant's repeated review(s) as outlined in **Section 01 45 23.13 – Observation Procedures**.

H. After review, distribute copies to all concerned parties.

I. The Contractor shall perform no portion of the Work for which the Contract Documents require submittals until the respective submittal has been reviewed by the Architect / Consultant without request for re-submittal.

3.5 CLAIM NOTIFICATION

A. If the submitter or Contractor issues submittals for which an additional cost is anticipated, the submittal must clearly indicate such cost including all supporting information.
   01 Lack of accompanying cost information known at the time of the original submittals shall be grounds for disallowance of such cost.

B. Upon return of submittal(s) to the originator of the submittal(s), the submitter shall thoroughly review all mark-ups and / or comments prior to proceeding with the Work.

C. Based on the mark-ups and / or comments returned, the submitter shall have fifteen (15) calendar days to submit a claim notification for additional costs the submitter may feel is warranted by the mark-ups / and or comments of the Architect or Consultant.
   01 The fifteen (15) calendar day period shall commence upon Contractor's receipt of the submittal from the Architect.

D. In the absence of any claim notification within the specified time period, it shall be agreed the submitter shall provide the Work in accordance with the final, reviewed submittal at no additional cost.

E. In the event a claim notification is submitted to the General Contractor / Construction Manager, the submittal process shall not be complete until all such claim notifications have been fully resolved.

END OF SECTION

SECTION 01 35 23

TOMBALL INDEPENDENT SCHOOL DISTRICT
OWNER SITE RULES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. The Contractor shall adhere to all Owner Site Rules at all times during the Work.
   01 Failure to adhere to Owner Site Rules may result in expulsion of personnel violating rules and / or fines as established on a district-wide basis by the Owner.

C. Owner site rules are in addition to all other regulatory rules to be adhered to by the Contractor.

1.2 OWNER SITE RULES

A. No foul language or spitting on floor.

B. No tobacco products on school property. On new construction projects, tobacco products are prohibited after air conditioning systems are initially activated.

C. The possession or use of alcohol or illegal drugs is strictly prohibited.

D. No tank tops – workers must be fully clothed.

E. No workers with a history of felony convictions or warrants.

F. No parking on grass, under shade trees, sidewalks or non-vehicular paved areas.

G. Entry into any occupied Tomball ISD facility must be cleared in advance with the District Facilities Department and at the campus level prior to scheduled entry. Upon arrival at the campus, all entrants must check in at the office for entry processing (i.e. Raptor system) and sign in and out at time of arrival and departure.

H. Contractor's employees, subcontractors and their agents and employees working on any District facility must wear picture identification with the company name. Any exceptions must be approved in advance with the designated District Representative.

I. Keep the premises free from accumulation of waste, materials or rubbish caused by the work under this Contract at each site. Boxes must be broken down prior to removal from the building. Upon completion of the Work, and prior to the final inspection, have the premises in a neat and clean condition.

J. Take all precautions necessary for the safety of, and provide protection to prevent damage, injury or loss to:
   01 All employees on the project and all other persons who may be affected thereby.
   02 All the work and all materials to be incorporated therein, whether in storage on or off the site.
   03 All property at the site and adjacent thereto including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and any other school property.

K. A competent supervisor who understands the full scope of the Work shall be on site at all times.

L. School administrative services shall at all times have priority over the Contractor's use / service / etc.

M. Any work that may interfere with school activities must be authorized in advance through administrative channels. A management plan will be devised to minimize the effect of the interference.

N. The Contractor shall be responsible to Tomball ISD for acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the Work under the Contract.

O. No work within the confines of a secured building will be allowed without a least one District custodian present. The Contractor must pay the Tomball ISD Custodial Department in advance for the cost of adding a custodian to a building for after-hours work.

P. Doors must not be propped open when working after-hours.

Q. Only the designated District representative who let the Contract for services will be authorized to sign documents that require releases or acceptance of Work by the District.

END OF SECTION

SECTION 01 36 13

CUTTING AND PATCHING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide cutting and patching of existing work as required for the proper installation of new work, including proper interface with existing work.
   02 Cutting and patching includes, but is not limited to:
      a. Gypsum board assemblies
      b. Finish flooring
      c. Wall finishes
      d. Doors and frames
      e. Ceiling assemblies

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Submit written request in advance of cutting or alteration which affects:
   01 Structural integrity of any element of the Project
   02 Integrity of weather-exposed or moisture-resistant element
   03 Efficiency, maintenance, or safety of any operational element
   04 Visual qualities of sight-exposed elements
   05 Work of Owner or separate Contractor
   06 Any work in or around any known or potential area in which asbestos or lead based products exist.

C. Procedural Proposal for Cutting and Patching: Where prior consent for cutting and patching is required, submit proposed procedures for this Work well in advance of the time work will be performed, and request consent to proceed. Include the following information, as applicable, in the submittal:
   01 Describe the nature of the Work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the Work in terms of changes to and effects upon existing work, including structural, operational and visual changes, as well as other significant elements.
   02 List products to be used and firms that will perform Work.
   03 Give dates when work is expected to be performed.
   04 List utilities that will be disturbed or otherwise be affected by Work, including those that will be relocated and those that will be temporarily out of service. Indicate how long utility services will be disrupted.
   05 Where cutting and patching of structural work involves the additional reinforcement, submit details and engineering calculations to show how that reinforcement is integrated with the original structure to satisfy requirements.

06 Consent by the Architect to proceed with cutting and patching work does not waive the Architect's right to later require complete removal and replacement of work found to be cut and patched in an unsatisfactory manner.

1.3 DESCRIPTION OF REQUIREMENTS

A. Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other Work and subsequent fitting, and patching required to restore surfaces to their original condition.
   01 Cutting and patching is performed for coordination of the Work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed, to remove and replace work not conforming to Contract requirements, or for other similar purposes.
   02 Cutting and patching performed during the manufacture of products, or during the initial fabrication, erection of installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be cutting and patching.

B. Refer to other Sections of these Specifications for specific cutting and patching requirements, and limitations applicable to individual units or work.
   01 Unless otherwise specified, requirements of this Section apply to Mechanical and Electrical Work. Refer to Divisions, 21, 22, 23, 26, 27 and 28 Sections for additional requirements and limitations on cutting and patching of Mechanical and Electrical Work.

1.4 RELATED REQUIREMENTS

A. Individual Specifications Sections:
   01 Cutting and patching incidental to Work of this Section.
   02 Advance notification to other trades of openings required in work of those trades.
   03 Limitations on cutting structural members.

1.5 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural work in a manner that would result in a reduction of load-carrying capacity or load-deflection ratio.

B. Before cutting and patching the following categories of Work, submit a written request and obtain the Architect's consent to proceed with cutting and patching, as described in the procedural proposal for cutting and patching.
   01 Structural steel
   02 Miscellaneous structural metals, including lintels, equipment supports, stair systems and similar categories of Work
   03 Structural concrete
   04 Foundation construction
   05 Shoring assemblies
   06 Bearing and retaining walls
   07 Structural decking
   08 Exterior wall construction
   09 Piping, ductwork, vessels and equipment

C. Operational and Safety Limitations: Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity, to perform in the manner intended, including energy performances, or that would result in increased maintenance, or decreased operational life, or decreasing safety. Before

cutting and patching the following elements of Work, and similar work elements where directed, obtain the Architect's consent to proceed with cutting and patching.

01 Shoring, bracing, and sheeting
02 Primary operational systems and equipment
03 Water/moisture vapor/air/smoke barriers, membranes and flashings
04 Noise and vibration control elements and systems
05 Control, communication, conveying, and electrical wiring systems
06 Special construction, as specified by Division 13 sections

D. Visual Requirements: Do not cut and patch work exposed on the building's exterior or in its occupied spaces, in a manner that would, in the Architect's opinion, result in lessening the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patch work. Remove and replace work judged by the Architect to be cut or patched in a visually unsatisfactory manner. If possible, retain the original installer or fabricator, or another recognized, experienced and specialized firm to cut and patch the following categories of exposed work:

01 Architectural concrete finishes
02 Brick and concrete unit masonry
03 Roofing
04 Preformed metal panels
05 Window system
06 Gypsum or cement plaster
07 Acoustical ceilings
08 Carpeting
09 Wall covering
10 HVAC enclosure, cabinets or covers

1.6 PAYMENT FOR COSTS

A. Cost for work necessary to accommodate installation of new work shall be borne by the Contractor or subcontractor responsible for installing new work.

B. Costs caused by ill-timed or defective work, or work not conforming to Contract Documents, including costs for additional services of the Architect and other Design Consultants shall be borne by the party responsible in the judgment of Architect, for ill-timed, rejected or non-conforming work.

C. Costs for work performed on instruction of Owner, other than the correction of defective or non-conforming work shall be responsibility of the Owner, who shall issue an appropriate Change Order for the increase in costs.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Except as otherwise indicated, or as directed by the Architect, use materials for cutting and patching that are identical to existing materials. If identical materials are not available or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible, with regard to visual effect. Use materials for cutting and patching that will result in equal-or-better performance characteristics.

PART 3 - EXECUTION

3.1 GENERAL

A. Execute cutting, fitting, and patching to complete work, and to:
   01 Fit several parts together which will integrate with other work.
   02 Uncover work to install ill-timed work.
   03 Remove and replace defective and non-conforming work.
   04 Remove samples of installed work for testing.
   05 Provide openings in elements of work for penetrations of mechanical and electrical work.
   06 Fill and refinish existing holes and damaged areas.

3.2 INSPECTION

A. Before cutting, examine the surface to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.

3.3 PREPARATION

A. To prevent failure, provide temporary support of work to be cut.

B. Protect other work during cutting and patching to prevent damage. Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.

C. Take precautions not to cut existing pipe, conduit or duct serving the building, but scheduled to be relocated until provisions have been made to bypass them.

3.4 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching work. Except as otherwise indicated or as approved by the Architect, proceed with cutting and patching at the earliest feasible time and complete work without delay.

B. Cut the work using methods that are least likely to damage work to be retained or adjoining work. Where possible, review the proposed procedures with the original installer; comply with original installer's recommendations.
   01 In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chipping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or core drill to ensure a neat hole. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover the opening when not in use.
   02 Comply with requirements of applicable Sections of Division 2 when cutting and patching, excavating, and backfilling.
   03 Bypass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated, or abandoned. Cut-off conduit and pipe in walls or partitions to be removed. After bypassing and cutting, cap, valve or plug, and seal tight the remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.

C. Patching: Patch with seams which are durable and as visible as possible. Comply with specified tolerances for the Work.

01 Where feasible, inspect and test patched areas to demonstrate integrity of work.

02 Restore exposed finishes of patched areas, and where necessary, extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and refinishing.

03 Where removal of walls or partitions extend one finished area into another finished area, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. If necessary to achieve uniform color and appearance, remove the existing floor and wall coverings and replace with new materials.

04 Where a patch occurs in a smooth painted surface, extend final paint coat over the entire unbroken surface containing the patch, after the patched area has received prime and base coat.

05 Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

D. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

E. At penetrations of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material, full thickness of the construction element.

F. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

3.5 CLEANING

A. Thoroughly clean areas and spaces where work is performed or used as access to work. Completely remove paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finish is applied. Restore damaged pipe covering to its original condition.

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS AND ACRONYMS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 TYPICAL TRADE ORGANIZATION AND INDUSTRY ABBREVIATIONS

Acoustical Society of America	ASA
Adhesive & Sealant Council, Inc.	ASC
Air Conditioning & Refrigeration Institute	ARI
Aluminum Association	AA
American Association of State Highway Officials	AASHO
American Concrete Institute	ACI
American Council of Independent Laboratories	ACIL
American Hardboard Association	AHA
American Hot-Dip Galvanizers Association	AHGA
American Institute of Architects	AIA
American Institute of Steel Constructors	AISC
American Institute of Timber Construction	AITC
American Iron & Steel Institute	AISI
American National Standards Institute, Inc.	ANSI
American Plywood Association	PA
American Society for Testing & Material	ASTM
American Society of Civil Engineers	ASCE
American Society of Heating, Refrigeration and Air Conditioning Engineers	ASHRAE
American Society of Mechanical Engineers	ASME
American Subcontractors Association	ASA
American Woodworking Institute	AWI
American Welding Society	AWS
American Wood Preserver's Institute	ASPI
Architectural Aluminum Manufacturers Association	AAMA
Architectural Woodwork Institute	AWI
Asphalt Institute	AI
Associated General Contractors of America	AGC
Brick Institute of America	BIA
Building Research Institute	BRI
California Redwood Association	CRA
Chain Link Fence Manufacturers Institute	CLFM
Concrete Reinforcing Steel Institute	CRSI
Construction Specification Institute	CSI
Door and Hardware Institute	DHI
Facing Tile Institute	FTI
Federal Specifications	FS
Flat Glass Marketing Association	FGMA
Gypsum Association	GA
Hardwood Plywood Manufacturers Association	HPMA
International Conference of Building Officials	ICBO
Joint Sealer Manufacturers Association	JSMA
Maple Flooring Manufacturers Association	MFMA
Metal Lath Association	MLA

National Association of Architectural Metal Manufacturers	NAAMM
National Association of Mirror Manufacturers	NAMM
National Bureau of Lathing & Plastering	NBLP
National Clay Pipe Institute	NCPI
National Concrete Masonry Association	NCMA
National Electrical Manufacturers Association	NEMA
National Environmental Systems Contractors	NESC
National Fire Protection Association	NFPA
National Forest Products Association	NFPA
National Hardware Lumber Association	NHLA
National Ornamental Metal Manufacturers Association	NOMMA
National Paint, Varnish and Lacquer Association	NPVLA
National Ready Mixed Concrete Association	NRMCA
National Roofing Contractors Association	NRCA
National Society of Professional Engineers	NSPE
National Woodwork Manufacturers Association, Inc.	NWMA
Painting and Decorating Contractors of America	PDCA
Perlite Institute, Inc.	PI
Portland Cement Association	PCA
Resilient Floor Covering Institute	RFCI
Rubber and Vinyl Floor Council	RVFC
Southern Building Code Congress	SBC
Southern Forest Products Association	SFPA
Southern Hardwood Lumber Manufacturing Association	SHLMA
Steel Deck Institute	SDI
Steel Door Institute	SDI
Steel Joist Institute	SJI
Steel Structures Painting Council	SSPC
Texas Accessibility Standards	TAS
Tile Council of America, Inc.	TCA
Underwriter's Laboratories, Inc.	UL
Venetian Blind Institute	VBI
Vinyl Fabrics Institute	VFI
West Coast Lumber Inspection Bureau	WCLIB
Western Red Cedar Lumber Association	WRCLA
Western Wood Products Association	WWPA

1.2 TYPICAL CONTRACT DOCUMENT ABBREVIATIONS

Acoustical	ACOUST	Corridor	CORR
Air Handling Unit	AHU	Diameter	DIA
Alternate	ALT	Dimension(s)	DIM or DIMS
		Door	DR
Aluminum	ALUM	Each	EA
Bottom	BOT	Electrical	ELECT
Building	BLDG	Elevation	ELEV
Carpet	CPT	Equal	EQ
Cast-In-Place	CIP	Existing	EX or EXIST
Centerline	CL	Expansion Joint	EJ or EXP JT
Ceramic Tile	CT or CER TILE	Exterior	EXT
Classroom	CR	Finish or Finished	FIN
Concrete	CONC	Finish Floor	FF or FIN FL
Concrete Masonry Unit	CMU	Fixture	FIXT
Construction Manager	CM	Floor	FL
Continuous	CONT	Floor Drain	FL

Flow Line	FL
Frame	FR
Galvanized	GALV
Gauge	GA
General Contractor	GC
Grade	GR
Gypsum Board	GB or GYP BD
Handicap	HC
Hardware	HW
Height	HT
Hollow Metal	HM
Hot Dipped Galvanized	HD GALV
Inside Diameter	ID
Insulation	INSUL
Interior	INT
Lavatory	LAV
Light	LT
Manhole	MH
Manufacturer	MFGR or MFR
Marker Bboard	MB
Masonry	MAS
Material	MATL
Match Existing	ME
Maximum	MAX
Metal	MTL
Minimum	MIN
Not in Contract / Work by Others	NIC
Office	OFF
On Center	OC
Outside Diameter	OD
Overflow Drain	OD
Paint	P or PT
Plastic Laminate	PL or PLAST LAM
Radius	RAD
Reflected Ceiling Plan	RCP
Reinforcing	REINF
Reinforced Concrete Pipe	RCP
Required	REQ
Resilient Tile	RT
Restroom	RR
Roof Drain	RD
Room	RM
Rough Opening	RO
Sanitary Sewer	SAN SWR
Schedule	SCHED
Sidewalk	SW
Similar	SIM
Sink	SK
Solid Core Plastic Laminate	SCPL
Space	SP
Stainless Steel	SS
Storage	STOR
Stormsewer	STM SWR
Suspended Acoustical Ceiling	SAC
Tack Board	TB
Temporary Bench Mark	TBM
Thick	THK
Top of Curb	TC or TOC
Top of Grate	TG or TOG
Top of Steel	TS or TOS
Treated	TRTD
Typical	TYP
Urinal	URIN
Vinyl Composition Tile	VCT
Vinyl Wall Covering	VWC
Water Closet	WC
Wood	WD

END OF SECTION

SECTION 01 45 23

TESTING AND INSPECTION SERVICES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 The Contractor shall allow in his proposal the coordination and supervision of tests to be performed by an independent laboratory selected by the Owner.
   02 All testing laboratory services shall be provided and paid for by the Owner outside of this Contract.
   03 A testing lab shall be selected by the Owner, and the Contractor shall be notified as soon as possible.
   04 The Contractor shall cooperate with the testing laboratory in all matters pertaining to the Work. The Owner retains the option to add to or delete any or all testing specified herein.

C. Related Work:
   01 Section 01 31 29 – Notification of Architect Requirements
   02 Section 01 45 23.13 – Observation Procedures
   03 Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals, or public authorities.
   04 Respective Sections of Specifications: Certification of products.
   05 Each Specification Section Listed: Laboratory test required and standards for testing.

D. Testing laboratory inspection, sampling and testing is required for:
   01 Division 03 – Concrete
   02 Section 04 20 00 – Unit Masonry
   03 Section 31 20 00 – Earth Moving
   04 Section 31 23 33 – Trenching and Backfilling
   05 Section 31 32 13.19 – Lime Soil Stabilization
   06 Electrical, plumbing and mechanical tests required in relative Sections.
   07 As requested by the Owner or Architect

1.2 AUTHORITIES AND DUTIES OF THE TESTING LABORATORY

A. The testing laboratory shall provide testing services under a separate agreement with the Owner or Architect, who shall be responsible for the costs of initial testing – pass or fail.
   01 The Contractor shall be responsible for costs of all re-tests required to achieve passing results.
   02 The Contractor shall be responsible for charges of the testing lab for expenses incurred for cancelled and / or mis-scheduled testing requests.
   03 The testing lab shall invoice Contractor direct for all re-tests of failed initial tests;

and send copies of the invoices to the Architect and Owner for record.

04 The testing lab and Contractor shall be responsible to negotiate and execute a separate agreement if required by the testing lab for charges described above.

B. The laboratory is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Specifications, or to approve or accept any portion of the Work.

01 When it appears that the material furnished or work performed by the Contractor fails to fulfill Specification requirements, the testing laboratory shall promptly notify the Contractor, Architect and Owner of work being tested of such deficiencies.

C. The laboratory shall promptly distribute copies of the laboratory test and inspection reports. Standard distribution shall include copies of all reports to the Owner, Architect, and Contractor.

01 The Structural Engineer, Civil Engineer, MEP Engineer, concrete supplier, and any outside Consultants shall receive copies of the testing results regarding their particular phase of the project.

02 Electronic distribution of test reports / results is mandatory.

D. The testing lab is required to furnish a report of the status of testing performed as it relates to anticipated expenses described in the Agreement with the testing lab. Reports shall be furnished at most bi-monthly to the Owner and Architect.

01 Report information shall include verification that Owner paid testing progress corresponds with anticipated expenses.

02 The testing lab shall be required to notify the Architect and Owner immediately if / when the testing lab anticipates exceeding the lump sum fee agreed to by the Owner.

03 Such notification must occur prior to expensing 75% of the testing lab fee.

1.3 TESTING LABORATORY CONTRACTUAL RELATIONSHIPS

A. The Owner shall contract with the Testing Laboratory outside the Owner-Contractor Agreement.

B. The Owner shall pay for the initial laboratory services / tests – pass or fail.

C. In the case of a failed test that does not meet the specified requirements, the Contractor shall be responsible for payment directly to the Testing Laboratory for all services / re-testing required to achieve a passing result.

01 The Owner shall not be invoiced for services or re-testing associated with failed initial tests.

D. The Owner shall not be responsible for Contractor's mismanagement or mis-scheduling of the Testing Laboratory that results in cost to the Testing Laboratory that do not result in Testing Laboratory performing its intended function (i.e. Contractor cancellation of Testing Laboratory services previously called for).

E. The Testing Laboratory record and document all retesting of failed initial tests and charges due to the mismanagement or mis-scheduling of the Contractor.

F. The Testing Laboratory is responsible for making separate arrangements with the Contractor for invoicing reimbursement of mismanaged services and re-testing associated with failed initial tests. Such expenses shall not be invoiced to the Owner.

1.4 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 project site.

B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for any hours over eight hours spent at the job site on a single day, field testing services performed on a Saturday or Sunday, and any field services performed on a recognized holiday.

C. Concrete design mixes will receive a cursory review with any discrepancies reported to the Architect.

D. Nuclear density testing will be based on a daily rental rate for the actual testing equipment; compensation on a per test basis will not be considered.

E. Report distribution shall include the Owner, Architect, Contractor, Civil Engineer, Structural Engineer, and others requesting or requiring review of the specific testing results.

F. Job site trips solely for cylinder pick-up shall be minimized. Whenever possible, cylinder / specimen pick-up shall be conducted when a technician is scheduled to be on-site for other testing work.

G. Structural steel inspections shall include a plant visit reviewing shop fabrication, welding and an overall review of the shop fabrication quality control standards. Structural steel field inspection shall include a 100% visual review of all field fillet welds and initial frequency of 25% ultrasonic testing of full field penetration welds. There shall be 100% visual review of all bolted connections, and a minimum of two (2) bolts tested at every bolted connection.

H. The Contractor shall bear the responsibility of scheduling all testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations and/or failed tests will be reimbursable to the Owner by the responsible party for the cancellation or failure of a test or service.

1.5 REFERENCES

A. Earthwork:
   01 ASTM D4318-10 – Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
   02 ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
   03 ASTM D6938-10 – Standard Test Method for In-Place Density and Water Content of Soil-Aggregate by Nuclear Method (shallow Depth)
   04 AASHTO T89 – Determining the Liquid Limit of Soils
   05 AASHTO T90 – Determining the Plastic Limit and Plasticity Index of Soils
   06 AASHTO T99 – Moisture-Density Relations of Soils

B. Concrete:
   01 ASTM C31/C 31M – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   02 ASTM C138 – Standard Test Method for Density (Unity Weight), Yield, and Air Content (Gravimetric) of Concrete.

03 ASTM C143 – Standard Test method for Slump of Hydraulic Cement Concrete.
04 ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
05 ASTM C231 – Standard Test method for Air Content of Freshly Mixed Concrete by the Pressure Method.
06 ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Mixed Cement Concrete.
07 ACI 301 – Specifications for Structural Concrete for Buildings.

C. Masonry:
01 ASTM C780-12 – Standard Test Method for Preconstruction and Construction Evaluation for Plain and Reinforced Unit Masonry
02 ASTM C109 / C109-11b – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 inch cube specimens).
03 ASTM C1019 – Standard Test Method for Sampling and Testing Grout.
04 ASTM C1314 – Standard Test Method for Compressive Strength of Masonry Prisms..

1.6 TESTS CONDUCTED

A. Earthwork:
01 Existing subgrade under building slabs and paving: In-place density tests for each 2,500 SF, or fraction thereof.
02 Select earth fill at building pad: In-place density tests for each 2,500 SF, or fraction thereof, of each compacted lift.
03 Proctor curve for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
04 Liquid limit of fill material.
05 Plastic limit and plasticity index of fill material.
06 Perform moisture content tests for each 5,000 SF of building pad immediately prior to placement of under-slab vapor membrane.
07 Earth fill at new paving: In-place density tests for each 4,000 SF, or fraction thereof, of each compacted lift.
08 Proctor curve for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
09 Liquid limit of fill material.
10 Plastic limit and plasticity index of fill material.
11 Trenching and Backfilling: In-place density tests for each 100 LF, or fraction thereof, of each compacted lift.
12 Soil Stabilization: Various tests relative to the requirements of Texas Highway Department Standard Specification for Construction of Highways, Streets and Bridges.

B. Cast-In-Place Concrete:
01 Review proposed concrete design mixes.
02 Provide full time services for the review of all drilled pier excavation and placement of concrete.
a. Include a daily report noting grid lines and locations of each pier drilled.
b. After the drilled pier shaft has been drilled, the lab shall test an undisturbed sample and verify that it meets or exceeds the design specification.
03 Provide on-site services for each concrete pour at all structural building concrete grade beams, slab on grade, columns, and other miscellaneous structural concrete.

a. Included within this scope of work is the review of all the rebar placement, size, spacing of stirrups, and miscellaneous placement requirements.

04 Cast four (4) concrete test cylinders for every 50 cubic yards or fraction thereof, placed on any day for structural concrete.

05 Cast four (4) concrete test cylinders for each 100 cubic yards, or fraction thereof, placed on any day for all other types of concrete.

06 Strength level of an individual class of concrete shall be considered satisfactory when both of the following criteria are met:

a. The arithmetic average of any three consecutive strength tests equal or exceed f'c.

b. No individual strength test (average of two cylinders) falls below f'c by more than 500 psi.

07 Conduct slump testing of concrete at intervals equal to test cylinders are made.

C. Masonry:

01 Provide pre-construction and construction evaluation of proposed mortars and grout(s).

02 Mortar Cubes: Cast four (4) mortar test specimens at random intervals during masonry work; one set specimen per 2,000 SF of surface area of masonry wall or veneer.

03 Masonry Grout: Cast four (4) grout test specimens at random intervals during masonry work; one set specimen per 2,000 SF of surface area of CMU wall, or fraction thereof.

04 Masonry Prisms: Tests shall be conducted for each 2,000 SF of surface area, or fraction thereof, on all CMU exterior (back-up) walls, and interior CMU walls 16' or taller.

D. Structural Steel:

01 Radiographic inspection shall be provided for all welds called for on the drawings as full penetration butt welds. If welds are inaccessible to radiograph, welds shall have ultrasonic inspection.

02 The testing of welded connections indicated on the drawings shall be paid for from the testing laboratory allowance; however, in the event the fabricator obtains approval from the structural engineers for additional welds not shown on the drawings, the cost of testing those additional welds shall be paid for by the Contractor.

E. Cementitious Fireproofing:

01 Verify all fireproofing has been installed to the depth(s) required to achieve the specified fire-resistance ratings.

F. Test Specimens:

01 Concrete Cylinder Specimens: Break one (1) at 7 days and two (2) at 28 days. If the 28 day break average exceeds minimum specified requirements, discard the fourth cylinder. If the 28 day break average is below specified minimum, hold and break the fourth cylinder at 56 days; or process as directed by the structural Engineer.

02 Grout Specimens: Break one (1) at 7 days and two (2) at 28 days. If the 28 day break average exceeds minimum specified requirements, discard the fourth cylinder. If the 28 day break average is below specified minimum, hold and break the fourth cylinder at 56 days; or process as directed by the structural Engineer.

03 Mortar Specimens: Break one (1) at 7 days and two (2) at 28 days. If the 28 day break average exceeds minimum specified requirements, discard the fourth cylinder. If the 28 day break average is below specified minimum, hold and break the fourth cylinder at 56 days; or process as directed by the structural Engineer.

PART 2 – GOVERNMENTAL INSPECTIONS AND CONTRACTOR TESTING

2.1 GOVERNMENTAL INSPECTIONS

A. The Contractor shall allow in his Proposal the application, coordination, scheduling and cost of all on-site inspections to be performed by governmental authorities having jurisdiction which are required for approval of the Work and occupancy of the building; including, but limited to:
   01 City departments
   02 County departments
   03 Flood Control Districts
   04 Municipal Utility Districts
   05 Health Departments
   06 Fire Marshal Offices

B. The Contractor shall also cooperate with Owner for all observations required by the Owner.

C. The Contractor shall make all corrective measures in accordance with instructions received from the governing authority inspector having jurisdiction, as required to receive 100% approval for the work being inspected.

D. The Contractor shall record and keep record of all governmental agency tests and inspections; including deficiencies noted by the agency, and corrective action(s) taken to receive final approval of the agency.

E. The Contractor shall bear all costs for initial inspections, re-inspections and any other expenses related to on-site inspections made by governing authorities.

F. No allowance shall be made for additional Contract Time, nor an increase in the Contract Sum for any unanticipated expenses or delays resulting from failed governmental inspection or resulting re-inspections required to obtain agency approval(s).

2.2 BELOW SLAB SANITARY SEWER TESTING

A. In addition to normal industry / governmental testing required for the sanitary sewer system, Contractor shall allow in his Proposal the application, coordination, scheduling and cost to provide a static water test(s) as described below.

B. The Contractor shall perform a static pressure test on all sanitary sewer piping systems below the building slab.

C. The test(s) shall be maintained continuously from the time the pipe installation is initially tested prior to final cover-up, and continue throughout all foundation preparation and placement of concrete slabs; and terminating a minimum of seven (7) days after the placement of concrete slabs.

D. Maintain sealed caps on all stub-ups to prevent dissipation of water within the piping system.

E. Any failure of the static testing indicating leakage during the above period shall be immediately reported to the Architect, MEP Engineer and Owner.

F. The Contractor shall be responsible for all corrective measures necessary to repair and / or replace defecting piping as directed by the Architect.

PART 3 – OWNER CONSULTANT OBSERVATIONS AND INSPECTIONS

3.1 GENERAL

A. Throughout the progress of the Work, the Owner's A/E consultants shall make regular site visits and prepare observation reports.

B. Refer to Specification Section 01 31 29 – Notification of Architect Requirements for specific observations required by the Architect, and the scheduling of such observations.

C. Contractor and A/E requested subcontractors shall be present for all A/E observations. Coordinate with A/E field representatives as required.

D. Contractor shall coordinate all trades as required to address issue or deficiencies identified on the observation reports.

E. Upon completion of corrective measures, Contractor shall note corrective measures, including date(s) on the observation report(s) and distribute the Architect.

3.2 TEXAS DEPARTMENT OF LICENSING AND REGULATION (TDLR)

A. The Owner /Architect shall be responsible for interfacing with Texas Department of Licensing and Registration (TDLR) regarding state approval for compliance with Texas Accessibility Standards.

B. The Owner /Architect shall make the initial submission of the Contract Documents for review.

C. TAS review comments affecting the Work shall be incorporated into the Work as directed by the Architect either by Addendum, Change Proposal Request, Minor Change or Clarification.

D. During the progress of the Work, the Contractor shall bring to the Architect's attention any portion of the Work that may be questionably compliant with TDLR / TAS.

E. The Architect shall coordinate and manage the TAS inspection of the completed project.
   01 TAS required corrective measures due to design issues shall be paid for by the Owner.
   02 TAS required corrective issues due to Contractor issues (materials, installation, etc.) shall be paid for by the Contractor.

F. All corrective work shall be completed within thirty (30) days after notification unless otherwise agreed upon by the Owner.

END OF SECTION

SECTION 01 45 23.13

OBSERVATION PROCEDURES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 The Contractor shall coordinate and cooperate with Architect and Architect's Consultants as required for on-site observations and monitoring of the Work.

C. Related Work:
   01 Section 01 31 29 – Notification of Architect Requirements
   02 Section 01 45 23 – Testing and Inspection Services

1.2 RELATED REQUIREMENTS

A. Coordination, scheduling and implementation of inspections and testing required by laws, ordinances, rules, regulations, orders or approvals, or public authorities required for interim and final approval of the Work shall be the sole responsibility of the Contractor.

B. Contractor shall maintain a log of all required governmental interim and final inspections throughout the progress of the Work.

PART 2 – PRODUCTS

2.1 GENERAL

A. Throughout the progress of the Work, the Owner's A/E consultants shall make regular site visits and prepare observation reports.

B. Contractor and requested subcontractors shall be present for all A/E observations. Coordinate with A/E field representatives as required.

C. Contractor shall coordinate all trades as required to address issue or deficiencies identified on the observation reports.

2.2 OBSERVATION REPORTS

A. Upon completion of on-site observations by the Architect and Architect's Consultants, documentation of the Observation shall be furnished to the Contractor.

B. Observation report items that reflect instructions for corrective measures shall be addressed / corrected by the Contractor in a timely manner.

C. Upon completion of corrective measures, Contractor shall detail corrective measures, including date(s) of work and date(s) of Contractor's verification of completeness on the observation report(s) and return a copy the Architect and Consultant as appropriate.

D. Wherever possible, Contractor's written documentation shall include all corrective work identified to be addressed on the observation report. Minimize piece meal responses as much as possible.

E. A complete history of Contractor's observation responses shall be required to be submitted as a condition of project close-out.

PART 3 – GENERAL – PROJECT CONSULTANT OBSERVATIONS

3.1 DESCRIPTION

A. The Contractor shall allow in his Proposal the coordination and scheduling of Observations to be performed by the Owner's project consultants; including the Architect, MEP Engineer, Structural Engineer, Food Service Consultant, Theater Consultant, and Special Systems Consultants as they may apply to this Work.

B. All project consultant observation services shall be performed by designees of the relative Consultant; upon which the Contractor may rely as to the capability and thoroughness of the observation being performed. Upon request by the Contractor, the names of A/E Field Representatives performing specific observations shall be furnished by the Architect.

C. The Owner shall pay for the observation services of the project consultants in accordance with the Owner – Architect Agreement and the requirements of the Contract Documents. Excessive observations and re-observations resulting from the Contractor's actions as described in this Section, shall be paid for by the Contractor directly to the affected Consultant.

D. The Contractor shall cooperate with the Owner's project consultants in all matters pertaining to required observations of the work as described in the Contract Documents. The Owner retains the option to add to or delete any or all observations specified herein; and thereby accept the relative work without observation.

E. Refer to Section 01 31 29 – Notification of Architect Requirements for additional information.

3.2 RELATED REQUIREMENTS

A. Conditions of the Contract, AIA Document A201, and Supplementary Conditions to the General Conditions for the Construction Contract, Specification Section CB.

B. Respective Sections of Specifications describing the required consultant observations.

3.3 AUTHORITIES AND DUTIES OF THE A/E FIELD REPRESENTATIVES

A. The project consultant representatives are not authorized to revoke, alter, relax, increase, or release the Contractor from any requirement of the Contract Documents without written notice furnished to the Contractor by the Architect.

B. When it appears that the material, assembly or work performed by the Contractor fails to fulfill Contract requirements, the project consultant representative shall promptly notify the General Contractor, Architect and Owner.

C. The project consultant representative(s) shall promptly distribute copies of the observation reports. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor.

3.4 PROJECT CONSULTANT OBSERVATION GUIDELINES AND PROCEDURES

A. Project Consultants shall make all observations required in the Contract Documents and requested by the Contractor and Owner.

B. For each material, assembly or phase observation required in the Contract Documents, and upon request by the Contractor, the project consultant(s) shall perform the following observations as required in the Owner – Architect Agreement; and shall be at the expense of the Owner in accordance with the Owner – Architect Agreement.:
   01 Initial observation to determine compliance with the Contract Documents.
   02 Observation to determine deficiencies where the initial observation results do not show 100% compliance with the Contract Documents. At the Consultant's discretion, this observation may be performed concurrent with the initial observation.
   03 Re-observation to determine 100% compliance with the Contract Documents.

C. In the event the observation series described above does not result in 100% approval of the material, assembly or phase being inspected, all subsequent re-observations required to achieve 100% approval shall be at the sole expense of the Contractor to be paid directly to the project consultant based on the Consultant's standard hourly rates for time expended, including travel to and from the site.

D. Recognizing the size and complexity of work included in a project may be sufficiently large enough to require the project to be divided into scope areas, each such area shall be considered separate and stand-alone with respect to Paragraph 3.4-B above.
   01 Requests by the Contractor for project consultant observations of partial scope completion areas shall be considered observations of the entire scope area with respect to Paragraph 3.4-B above; and subsequent observations of the remaining portions of the same scope area shall be paid for directly to the Consultant by the Contractor.
   02 Consultants shall invoice the Contractor on a monthly basis, and payment shall be due upon the Contractor's receipt of the invoice.

E. The Contractor shall bear the responsibility of requesting and scheduling all project consultant observations required by the Contract Documents. The Contractor shall give the project consultant a minimum of forty-eight (48) hours' notice prior to the requested observation.
   01 No extension of Contract Time shall be granted for untimely observations due to the Contractor's failure of proper observation request notification.

F. Observations voluntarily made by project consultants at their discretion, not specifically requested by the Contractor, shall not count as one of the observations described in Paragraph 3.4-B above, nor shall the Contractor be liable for any related expenses.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide temporary facilities adequate to facilitate the requirements to complete the Work.
   02 Any areas disturbed by the placement of temporary facilities shall be repaired / replaced to a finished condition consistent with the surrounding finished area.

C. Related Work:
   01 Section 01 56 39 – Temporary Tree and Plant Protection

PART 2 - GENERAL

2.1 GENERAL

A. Unless otherwise agreed upon or stipulated in the Contract Documents, the Contractor shall provide all necessary temporary facilities required to effectively implement and complete the Work.

B. Temporary facilities shall be provided only for the duration of construction, unless agreed upon otherwise, and all temporary facilities shall be completely removed at the completion of the project.

C. Any areas disturbed by the placement of temporary facilities shall be repaired / replaced to a finished condition consistent with the surrounding finished area.

2.2 UTILITIES

A. The Contractor shall supply temporary job power for the Work. The Contractor shall provide all wiring, lamps, distribution of power and similar equipment as required for construction, inspection, and testing of each project.
   01 Coordinate with the local power provider as required.
   02 The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.
   03 For work at existing campuses / buildings, Contractor may have access to existing 110 / 120 volt receptacles. Coordinate with Owner to confirm access and usage.

B. The Contractor shall supply reliable data / internet capability at the job site trailer for use by the Contractor, Architect and Owner.
   01 Contractor shall provide hard wired data connections as required for his use.
   02 The Contractor provide wireless connectivity (i.e. mobile broadband devices) for use by up to five (5) simultaneous users and a minimum speed of 50Mb per second.

C. The Contractor shall supply temporary water for the Work. The Contractor shall provide all distribution, valves, fixtures and similar equipment as required for construction, inspection, and testing of each project.
   01 Coordinate with the local provider as required.
   02 The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.
   03 For work at existing campuses / buildings, Contractor may have access to existing water supply / hose bibbs. Coordinate with Owner to confirm access and usage.

D. The Contractor shall provide temporary heat to prevent freezing and maintain proper temperatures to avoid damage to materials and assemblies in the building.

E. The Contractor shall provide and maintain such dependable source of temporary utilities as may be necessary until the building is converted to permanent power and utility connection(s).

F. Where a permanent irrigation system is not in use, the Contractor shall be required to provide temporary water at locations where new sod is installed.
   01 These connections must be maintained through the duration of the Contract, or until the work is accepted, whichever is later.

2.3 FIELD OFFICE

A. The Contractor will be required to furnish a job trailer installed at a suitable location (on site), for use by the Owner, Contractor, and Architect.
   01 Coordinate with the Owner and Architect for acceptable location.

B. Provide and maintain a weather-tight building with operable and lockable door and windows, to serve as a job office available to the Contractor, subcontractors, and the Architect.

C. Provide lights, electricity, air conditioning and heat, as required.

D. Remove office from premises at completion of work or when a similar area / room can be set up inside the building, contingent on approval from the Owner.

E. Provide job site data / computer connection, telephone and fax, and other miscellaneous items as outlined below.
   01 The job site trailer shall have a hard-wired data service for Contractor’s use.
   02 Contractor’s office shall be of a size, and shall be furnished, so that it may be used for progress meetings.
   03 Provide adequate artificial lighting, heating, and cooling to provide comfortable conditions for occupants.

F. Furnishings Required:
   01 Contractor's Office: Racks and files for Contract Documents and for Record Documents; conference table and chairs; and desks and chairs as required by Contractor.
   02 Architect's Office: One plan table large enough to house a full size set of drawings and a chair.

2.4 SANITARY FACILITIES

A. Furnish temporary sanitary facilities and maintain in compliance with regulations of State Department of Health and other authorities having jurisdiction.

B. Maintain a regular service schedule for the facilities.

C. Use of Owner's sanitary facilities is strictly prohibited.

2.5 STORAGE FACILITIES

A. Provide and maintain adequate weather tight, lockable, enclosed storage facilities as required to securely house materials and equipment stored on the job site.
   01 Coordinate with the Owner and Architect for acceptable location(s).

B. Replace materials improperly stored and damaged by weathered conditions.

C. Allow for temporary freeze protection as required.

D. Remove storage facilities at completion of work or when materials are stored within the structure in a weather tight condition.

2.6 SIGNS

A. Within three (3) weeks after receipt of Notice to Proceed, provide one project identification sign and install at designated location at the site.

B. Fabricate the sign with sturdy wood framing and 3/4 inch thick exterior grade plywood, with medium density overlay, and a minimum area of 64 square feet (4' x 16' or 8' x 8').

C. Erect signs on 4" (102 mm) x 4" (102 mm) supports set firmly into the ground and well braced. The bottom of the sign is to be a minimum of 4' above grade, unless otherwise instructed by the Architect.

D. Prime wood surfaces and apply one coat of exterior house paint, in not more than three distinct colors.

E. Architect shall provide camera ready artwork for use in making the project sign; and shall include:
   01 The official title of the Project.
   02 The name of the Owner.
   03 3-D rendering
   04 The names and titles of School Board Members and School Administrators.
   05 The names of Architect and professional consultants.
   06 Name of the Contractor / Construction Manager.

F. Other signs permitted at the site:
   01 Warning signs.
   02 Directional signs.
   03 Identification signs at field offices.

G. Allow no other signs to be displayed at the project site, unless authorized by the Owner.

H. Secure and pay for all sign permits as required by local authorities.

2.7 BARRIERS

A. Provide temporary barricades on all portions of the site adjacent to the construction and accessible to the public.
   01 Temporary barricades shall be a minimum 72” tall chain link, self-supported fence.
   02 Provide lockable personnel and equipment gates as required for adequate access.
   03 Maintain fencing in good condition throughout the progress of the Work.

B. Where Work occurs on existing campuses or buildings, coordinate with the Owner and Architect for layout of fencing to facilitate normal Owner operations as much as possible.

C. Provide approved barriers around trees and plants designated to remain as required to protect against damage from vehicular / personnel traffic, stored materials, dumping, chemically injurious materials, and water ponding.

2.8 SECURITY

A. Determine if and when watchmen are necessary for protection to the work, and provide such services when necessary.

B. Neither the provision of watchmen nor the failure to provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

2.9 CLEANING

A. Trash Removal:
   01 Clear the building and site of trash a minimum of once a week.
   02 When rapid accumulation occurs, make more frequent removals.
   03 Remove highly combustible trash such as paper and cardboard daily.
   04 Dumpsters will not be allowed to overflow and should be emptied on a regular basis.
   05 Use of Owner’s dumpsters and trash receptacles is strictly prohibited.

B. Disposition of Debris:
   01 Remove debris from the site and legally dispose of in strict accordance with local ordinances and regulations.
   02 Locations for disposal shall be of the Contractor's choice within the above restriction.
   03 No debris or material may be buried or burned at the site.
   04 Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.

C. Cleaning:
   01 Maintain installed work in a manner that will protect the work.
   02 Thoroughly clean the work, including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations, and other foreign materials.

2.10 TEMPORARY FIRST AID FACILITIES

A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.

B. Provide a sign, posted at the telephone, listing the telephone numbers for emergency medical services: physicians, ambulance services and hospitals.

2.11 TEMPORARY FIRE PROTECTION

A. Provide a fire protection and prevention program for employees and personnel at the site.
   01 For work on existing campuses or buildings, coordinate with the Owner and Architect to develop a program that will facilitate the Owner's needs (i.e. building evacuation and similar).
   02 Where existing building users must evacuate into a work area, coordinate with the local fire marshal having jurisdiction to implement temporary measures required to maintain life safety code compliance.

B. Provide and maintain fire extinguishing equipment ready for instant use at all areas of the project, and at specific areas of critical fire hazard.

C. Equipment:
   01 Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
   02 Barrels of water with buckets designated for fire control purposes.
   03 Water hoses connected to an adequate water pressure and supply system.
   04 Construction period use of permanent fire protection system.

D. Enforce Fire-safety Discipline:
   01 Store volatile materials in an isolated, protected location.
   02 Avoid accumulations of flammable debris and waste in or about the Project.
   03 If allowed on site at all, prohibit smoking in the vicinity of hazardous conditions.
   04 Closely supervise welding and torch-cutting operations.
   05 Supervise locations and operations of portable heating units and fuel.

E. Maintain fire extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.

2.12 CONSTRUCTION AIDS

A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the work; including, but not limited to scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.

B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.

C. Maintain all equipment in a first-class, safe condition.

2.13 ACCESS ROADS AND PARKING AREAS

A. Provide adequate temporary roads and walks to achieve all-weather access into the site from public thoroughfares, and within and adjacent to the site, as necessary to provide uninterrupted access to field offices, work and storage areas.

B. For work performed on existing, occupied site, coordinate with the Owner and Architects for location(s) of temporary access and construction parking.
   01 Where Contractor is allowed to use existing access roads, paving, parking, sidewalks and similar, Contractor shall thoroughly photograph or video all such areas to document existing conditions.
   02 Contractor shall repair / replace any area(s) damaged as the result of construction activities.

C. Provide adequate parking space for personnel and employees at the site, located to avoid interference with traffic, work or storage areas, or with materials-handling equipment.

D. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

E. All temporary access roads and walks shall be removed upon completion of permanent facilities, or completion of construction.

F. All disturbed areas shall be minimally regenerated to their original condition.

END OF SECTION

SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide protection at existing trees and planted materials designated to remain on site as required to prevent damage or degradation.

C. Related Work:
   01 Section 31 11 00 – Clearing and Grubbing
   02 Section 31 20 00 – Earth Moving
   03 Section 31 22 19 – Finish Grading
   04 Section 31 32 13.19 – Lime Soil Stabilization

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed materials and assemblies to be used to protect existing trees.
   01 Shop Drawings shall indicate limits of fencing and all new work that may occur within the protection zone.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Prior to start of Work, Contractor shall photographically document existing vegetation, plants and trees in order to capture the condition of existing vegetation, plants and trees.
   01 Such documentation shall be used at the conclusion of the Work to verify that vegetation, plants and trees are in the same condition prior to start of the Work.

1.3 QUALITY ASSURANCE

A. A pre-construction meeting shall be given to explain tree preservation and treatment during the construction process by the Architect.

B. Site preparation work shall not begin in any area where tree preservation and treatment measures have not been completed.

C. Site improvements shall be staked by the Contractor in order to facilitate location of trenching and fencing operations.

D. Any roots exposed by construction activity shall be pruned flush with the ground and covered with backfill as soon as possible. If exposed roots are not to be covered with backfill within twenty-four (24) hours, cover with a mulch or material in order to reduce soil temperature and minimize water loss due to evaporation.

E. Any work, excavation or grading required within protected root zone areas shall be limited to 3 inches cut or fill, with no roots over 3/4 inch diameter being out, and done by hand or with approved equipment and root protection.

1.4 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   01 Storage of construction materials, debris, or excavated material
   02 Parking vehicles or equipment
   03 Foot traffic
   04 Erection of sheds or structures
   05 Impoundment of water
   06 Excavation or other digging unless otherwise indicated
   07 Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 – PRODUCTS

2.1 TREE PROTECTION MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter, and free of weeds, roots, and toxic and other non-soil materials.
   01 Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.

B. Topsoil: Complying with plant material notes as indicated on the Drawings.

C. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   01 Type: Pine Straw
   02 Color: Natural
   03 Application: Four (4) inches thick

D. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:
   01 Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2 inch (50 mm) opening, 0.148 inch (3.76 mm) diameter wire chain-link fabric; with pipe posts, minimum 2 -318 inch (60 mm) OD line posts, and 2-718 inch (73 mm) OD comer and pull posts; with 1-518 inch (42 mm) OD top trails, with 0.177 inch (4.5 mm) diameter top tension wire and 0.177 inch (4.5 mm) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
   02 Height: 6 feet (1.8 m)
   03 Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm)

E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
   01 Size and Text: 18”x 24”
   02 Lettering: 3 inch (75 mm) high minimum, white characters on red background

2.2 IMPLEMENTATION

A. A 24” deep x 4” wide trench shall be cut 1’-0” in from the new concrete line, lined with polyurethane plastic sheeting and backfilled. Plastic should line both sides of trench and ends of plastic should be exposed to assure proper positioning. The trench is to protect the existing root system from damage. The plastic is to restrict leaching of lime to the roots during the lime stabilization process.

B. A temporary protective fence shall be installed completely around the existing trees to remain. The location of the protective fence shall be verified with Architect. The protected area shall not be used for any reasons, including material, vehicular, and equipment storage or vehicular traffic and parking.

C. A certified Arborist shall be contracted to trim trees in the protected area, and oversee and verify that the root systems have not been damaged during the construction process. The following is a list of locally approved Arborists:
   01 Champions Tree Services, Inc.
   02 Davey Tree Service
   03 Trees Incorporated

D. Trimming Operation:
   01 The Architect and Owner shall be notified of all trimming.
   02 Trees to be trimmed will include only trees affected by construction and those requiring maintenance in the preservation areas.
   03 Trees to be trimmed will be designated flagged in the field.
   04 Trees to be removed shall be designated by Architect.
   05 A list of the trees to be trimmed and the prescribed tree treatment will be provided by the Arborist.
   06 Trimming shall consist of the following methods:
      a. Class IV - Crown Reduction Pruning (reference National Arborist Association Standards for Pruning of Shade Trees 1988). Special trimming procedure to reduce crown of trees up to 30 percent, to prevent impact and stress of preservation trees. Corrective pruning and removal of all deadwood larger than 1 inch diameter will be required.
      b. Removal of all vines from trees.
      c. Removal of designated and or hazardous trees. All stumps shall be ground down 6 inches below grade.
      d. All chips produced from the trimming operation shall be left on site for Owner's use, unless otherwise directed. Chips will be blown onto or spread over preservation areas.
   07 All wood not chipped shall be hauled from site. No burning will be allowed on site.

E. Root Pruning Trenching Operation:
   01 Trenching areas shall be designated and exact locations will be marked in the field.
   02 Trenching depth shall be 2 foot minimum.
   03 Where excavation over 3 inches in depth is to occur within the root zone area of a preserve tree, make a clean cut (a minimum of 2 feet deep) between the designated disturbed and undisturbed root zone area, with a trenching machine, in order to minimize damage to the undisturbed root zone.
   04 Trench shall be backfilled and compacted immediately after trenching.

F. Tree Protection Fencing Installation:
   01 Tree protection fence - the exact locations will be marked in the field by the Architect.
   02 No access to fenced areas shall be permitted without prior approval by the Architect.
   03 Contractor shall provide maintenance and repair of fence during site work construction.
   04 Fence shall be removed after completion of site work construction, unless otherwise notified.

G. Fertilization Treatment:
   01 All preservation trees shall be treated, as designated by the Architect.
   02 Injection of a liquid mix of 50 percent Doggett XL Injecto feed and 50 percent "Maxicrop" into the root zone area of trees shall consist of the following method:
      a. Mix one pound of "Maxicrop" per 100 gallons water with Doggett XL Injecto Feed per label instructions in tank with agitation capability.
      b. Inject the mixture on a 3 foot square grid at 5 gallons per 100 square feet.
      c. Injection pressure shall be 100-150 psi as soil conditions warrant.
      d. Depth of injection will be 12 inches.

03 Mix approved wetting agent by label directions with mixture in order to provide better distribution and penetration of materials into soil.

H. Repair Operations:

01 If any damage to preservation trees should occur beyond what is expected during the construction period, the Architect and Arborist shall appraise the damage and order the repair by the Contractor or responsible party.

02 Trees lost due to contractor's negligence during the construction period shall be appraised by the Arborist and the Owner compensated or replacement trees provided.

2.3 REPAIR AND REPLACEMENT

A. The Contractor's photographic documentation of existing vegetation, plants and trees prior to start of Work shall be used to compare against condition vegetation, plants and trees at the conclusion of the Work.

B. The Contractor shall repair and / or replace all existing vegetation slated to remain that have been damaged as a result of Contractor activities.

C. Such repair and / or replacement shall restore vegetation, plants and trees to their original condition prior to start of Work at no expense to the Owner.

D. Replacement of vegetation, plants and trees shall be the same species and size of the original specimen.

E. All repairs and / or replacements shall be made at no additional cost to the Owner.

END OF SECTION

SECTION 01 55 13.10

STABILIZED CONSTRUCTION ENTRANCE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.2 SUBMITTALS

A. Manufacturer's catalog sheets and other product data on geotextile fabric.

B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.3 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.

B. When indicated in the Unit Price Schedule, include stabilized exits under payment for Street Cleaning as Required by NPDES, including stabilized construction roads, parking areas, exits, and truck washing areas will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, embankment and excavation, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, redressing of aggregates and stones, cleaning of streets, and removal of erosion and sediment control systems at the end of construction.

1.4 REFERENCES

A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

PART 2 P R O D U C T S

2.1 GEOTEXTILE FABRIC

A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. 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.

C. 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 6 months of expected usable life at a temperature range of 0°F to 120°F.

D. Representative Manufacturers: Mirafi, Inc., or equal.

2.2 COARSE AGGREGATES

A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or a combination of these materials. 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
¾”	60 - 80
No. 4	95 - 100

PART 3 E X E C U T I O N

3.1 PREPARATION AND INSTALLATION

A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner’s Representative to allow soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner’s Representative to remove and discard the existing system.

D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the Owner. Remove stabilized construction roads and exits promptly when directed by the Owner’s Representative. Discard removed materials off site in accordance with the requirements of Division 1.

E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at location not in or adjacent to a stream or floodplain. Off-site disposal is 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 a 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 shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.

G. Conduct all construction operation under this Contract in conformance with the erosion control practices described in Division 1.

3.2 CONSTRUCTION METHODS

A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.

B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.

C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. 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.

D. Details for stabilized construction exit are shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. 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 14 days to minimize damage potential.

E. 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 public right-of-way, receiving stream or storm water conveyance system.

F. 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 control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

G. The length of the stabilized area shall be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than the full width of all points of ingress or regress.

H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.

I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.

J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the City Engineer. These methods 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.

END OF SECTION 01 55 13.10

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SECTION 01 55 26

TRAFFIC CONTROL

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.

B. Qualifications and requirements for use of flagmen.

1.2 MEASUREMENT AND PAYMENT

A. Unit Price Contracts.

1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.
2. Flagmen. Payment for flagmen is on a lump sum basis. Partial payments will be based on Contractor's Schedule of Values for flagmen.
3. New Portable Concrete Low Profile Traffic Barrier Provided. Payment is on a unit price basis for each linear foot of low profile traffic barrier provided, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
4. Portable Concrete Low Profile Traffic Barrier picked up from Stockpile. Payment is on a unit price basis for each linear foot of low profile traffic barrier picked up from designated stockpile, moved onto the project, set at location and connected together.
5. Portable Concrete Low Profile Traffic Barrier Installed. Payment is on a unit price basis for each linear foot of low profile traffic barrier delivered to the project location, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
6. Portable Concrete Low Profile Traffic Barrier Moved and Reset. Payment is on a unit price basis for each linear foot of low profile traffic barrier disassembled, moved on the project, reset at the new locations and connected together. Include cost to repair roadway in the unit price.
7. Portable Concrete Low Profile Traffic Barrier Removed. Payment is on a unit price basis for each linear foot of low profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Division 1. Include cost to repair roadway in the unit price.
8. Refer to Division 1 for unit price procedures.

B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

1.3 REFERENCES

A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)

B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Traffic control plan:

1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.
2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.

C. Submit copies of approved lane closure permits issued by all governmental authorities.

D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.

E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

1.5 FLAGMEN

A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes.

B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.

1. Uniformed Peace Officers may be:
   a. Sheriffs and their deputies;
   b. Constables and deputy constables;
   c. Marshals or police officers of an incorporated city, town or village; or
   d. As otherwise provided by Article 2.12, Code of Criminal Procedure.
2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.

C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:

1. Formally trained and certified in traffic control procedures by the City's E. B. Cape Center.
2. Speaks English. Ability to speak Spanish is desirable but not required.
3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the City of Houston's Wage Scale for Engineering Construction.

D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

PART 2 P R O D U C T S

2.1 SIGNS, SIGNALS, AND DEVICES

A. Comply with TMUTCD requirements.

B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

2.2 PORTABLE LOW PROFILE CONCRETE BARRIERS

A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

PART 3 E X E C U T I O N

3.1 PUBLIC ROADS

A. Submit requests forms for lane closure and sidewalk closure to the appropriate governmental authority at least three working days prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits.

B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Owner's Representative.

C. Give Owner's Representative one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.

D. Notify police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.

E. Maintain 10-foot-wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.

F. Do not to obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by Owner's Representative.

G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Owner's Representative to maintain temporary driveway access to commercial and residential driveways.

H. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with applicable ordinances.

I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.

J. Provide safe access for pedestrians along major cross streets.

K. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

L. Do not close more than two consecutive esplanade openings at a time without prior approval from Owner’s Representative.

3.2 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Owner's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.3 FLARES AND LIGHTS

A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.4 HAUL ROUTES

A. Utilize haul routes designated by authorities or shown on Drawings for construction traffic.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify the governmental agency having jurisdiction a minimum of 60 days in advance of need for control boxes and switchgear. The Contractor will pay for all necessary service, programming or adjustments, to signal boxes and switchgear if required during construction.

B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.

C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.

D. Unless otherwise approved by Owner’s Representative, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.

E. Replace existing traffic control devices in Project area.

F. Owner’s Representative may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the Owner.

3.6 BRIDGING TRENCHES AND EXCAVATIONS

A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.

B. Shore trench or excavation to support bridge and traffic.

C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:

1. Bridging is placed over existing bus routes,
2. More than five percent of daily traffic is comprised of commercial or truck traffic,
3. More than two separate plates are used for bridging, and
4. When bridge is to be used for more than five consecutive days.

D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.7 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

C. Remove post settings to a depth of 2 feet.

3.8 TRAFFIC CONTROL, REGULATION AND DIRECTION

A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:

1. Multi-lane vehicular traffic must be diverted into single lane vehicular traffic,
2. Vehicular traffic must change lanes abruptly,
3. Construction equipment must enter or cross vehicular traffic lanes and walks,
4. Construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks,
5. Traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and
6. Where construction activities might affect public safety and convenience.

B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

3.9 INSTALLATION STANDARDS

A. Place temporary pavement for single lane closures, in accordance with TMUTCD.

B. Reinstall temporary and permanent pavement markings as approved by Owner's Representative. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Owner's Representative for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

A. Submit name, address and telephone number of individual designated to be responsible for maintenance of traffic handling at construction site to Owner's Representative. Individual

must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.

B. Inspect signs, barricades, drums, lamps and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by Owner's Representative. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.

C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.

D. Obtain approval of Owner's Representative to reuse damaged or vandalized signs, drums, and barricades.

END OF SECTION 01 55 26

SECTION 01 56 19

TREE PROTECTION AND CARE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Tree and plant protection.

1.2 PROJECT CONDITIONS

A. Preserve and protect existing trees and plants to remain from foliage, branch, trunk, or root damage that could result from construction operations.

B. Prevent following types of damage:

1. Compaction of root zone by foot and/or vehicular traffic or material storage.
2. Trunk damage from equipment operations, material storage, or from nailing or bolting.
3. Trunk and branch damage caused by ropes or guy wires.
4. Root poisoning from spilled solvents, gasoline, paint, and other noxious materials.
5. Branch damage due to improper pruning or trimming.
6. Damage from lack of water due to:
   a. Cutting or altering natural water migration patterns near root zones.
   b. Failure to provide adequate watering.
7. Damage from alteration of soil pH factor caused by depositing lime, concrete, plaster, or other base materials near roots.
8. Cutting of roots larger than 1-½ inches in diameter.

1.3 DAMAGE ASSESSMENT

A. When trees other than those designated for removal are destroyed or badly damaged as a result of construction operations, remove and replace them with same size, species, and variety up to and including eight (8) inches in trunk diameter. Tree larger than eight (8) inches in diameter shall be replaced with an 8-inch diameter tree of the same species and variety and total contract amount will be reduced by an amount determined from the following International Shade Tree Conference formula: $0.7854 \times D^2 \times \$38.00$ where D is diameter in inches of tree or shrub trunk measured twelve (12) inches above grade.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Asphalt Paint: Emulsified asphalt or other adhesive, elastic, antiseptic coating formulated for horticultural use on cut or injured plant tissue, free from kerosene and coal creosote.

B. Burlap: Suitable for use as tree wrapping.

C. Fertilizer: Liquid containing 20-percent nitrogen, 10-percent phosphorus, and 5-percent potash.

D. All necessary tree replacements shall be as approved by the Engineer.

PART 3 E X E C U T I O N

3.1 PROTECTION AND MAINTENANCE OF EXISTING TREES AND SHRUBS

A. Except for trees and shrubs shown on Drawings to be removed, all trees and shrubs within the project area are to remain and be protected from damage.

B. For trees or shrubs to remain, perform the following:

1. Trimming of trees and shrubs to remain shall be done only under supervision of professional tree surgeon or horticulturist.
   a. Tree pruning will be according to International Society of Arborculture specifications.
   b. Trees and shrubs requiring pruning for construction should also be pruned for balance as well as to maintain proper form and branching habit.
   c. Cut limbs at branch collar. No stubs should remain on trees. Branch cuts should not gouge outer layer of tree structure or trunk.
2. Use extreme care to prevent excessive damage to root systems.
   a. Roots in construction areas will be cut smoothly with a trencher before excavation begins. Do not allow ripping of roots with a backhoe or other equipment.
   b. Temporarily cover exposed roots with wet burlap to prevent roots from drying out.
   c. Cover exposed roots with soil as soon as possible.
3. Prevent damage or compaction of root zone (area below dripline) by construction activities.
   a. Do not allow scarring of trunks or limbs by equipment or other means.
   b. Do not store construction materials, vehicles, or excavated material under dripline of trees.
   c. Do not pour liquid materials under dripline.
4. Water and fertilize trees and shrubs that will remain to maintain their health during construction period.
   a. Supplemental watering of landscaping during construction should be done once every seven (7) days in cold months and once every four (4) days in hotter months.
   b. This watering shall consist of saturating soils at least six (6) to eight (8) inches beneath surface.
5. Water areas currently being served by private sprinkler systems while systems are temporarily taken out of service to maintain health of existing landscapes.
6. At option of the Contractor, and with the Engineer's permission, trees and shrubs to remain may be temporarily transplanted and returned to original positions under supervision of professional horticulturist.

3.2 PROTECTION

A. Protection of Trees or Shrubs in Open Area:

1. Install steel drive-in fence posts in protective circle, approximately 8 feet on center, not closer than four (4) feet to trunk of trees or stems of shrubs.
2. Drive steel drive-in fence posts three (3) feet minimum into ground, leaving five (5) feet minimum above ground.
3. Mount steel hog-wire on fence posts.

4. For trees or shrubs in paved areas, mount concrete-filled steel pipe 2-½ inches in diameter minimum in rubber auto tires filled with concrete (movable posts).

B. Timber Wrap Protection for Trees in Close Proximity of Moving or Mechanical Equipment and Construction Work:

1. Wrap trunk with layer of burlap.
2. Install 2 x 4's or 2 x 5's (5-foot to 6-foot lengths) vertically, spaced three (3) inches to five (5) inches apart around circumference of tree trunk.
3. Tie in place with twelve (12) to nine (9) gauge steel wire.

3.3 MAINTENANCE OF NEWLY PLANTED TREES

A. Show proof of capacity to water during dry periods.

B. The Contractor guarantees that trees planted for this Project shall remain alive and healthy at least until the end of a one-year warranty period and the additional one year period required by the Surface Restoration Bond.

1. Within four (4) weeks of notice from Owner, Contractor shall replace, at his expense, any dead trees or any trees that in the opinion of Owner, have become unhealthy, unsightly, or have lost their natural shape as a result of additional growth, improper pruning or maintenance, or weather conditions.
2. When tree must be replaced, the guarantee period for that tree shall begin on date of replacement of tree, subject to the Owner's inspection, for no less than one year.
3. Straighten leaning trees and bear entire cost.
4. Dispose of trees rejected at any time by Owner or Engineer at Contractor's expense.

END OF SECTION 01 56 19

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SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide protection at existing trees and planted materials designated to remain on site as required to prevent damage or degradation.

C. Related Work:
   01 Section 31 11 00 – Clearing and Grubbing
   02 Section 31 20 00 – Earth Moving
   03 Section 31 22 19 – Finish Grading
   04 Section 31 32 13.19 – Lime Soil Stabilization

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed materials and assemblies to be used to protect existing trees.
   01 Shop Drawings shall indicate limits of fencing and all new work that may occur within the protection zone.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Prior to start of Work, Contractor shall photographically document existing vegetation, plants and trees in order to capture the condition of existing vegetation, plants and trees.
   01 Such documentation shall be used at the conclusion of the Work to verify that vegetation, plants and trees are in the same condition prior to start of the Work.

1.3 QUALITY ASSURANCE

A. A pre-construction meeting shall be given to explain tree preservation and treatment during the construction process by the Architect.

B. Site preparation work shall not begin in any area where tree preservation and treatment measures have not been completed.

C. Site improvements shall be staked by the Contractor in order to facilitate location of trenching and fencing operations.

D. Any roots exposed by construction activity shall be pruned flush with the ground and covered with backfill as soon as possible. If exposed roots are not to be covered with backfill within twenty-four (24) hours, cover with a mulch or material in order to reduce soil temperature and minimize water loss due to evaporation.

E. Any work, excavation or grading required within protected root zone areas shall be limited to 3 inches cut or fill, with no roots over 3/4 inch diameter being out, and done by hand or with approved equipment and root protection.

1.4 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   01 Storage of construction materials, debris, or excavated material
   02 Parking vehicles or equipment
   03 Foot traffic
   04 Erection of sheds or structures
   05 Impoundment of water
   06 Excavation or other digging unless otherwise indicated
   07 Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 – PRODUCTS

2.1 TREE PROTECTION MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) in diameter, and free of weeds, roots, and toxic and other non-soil materials.
   01 Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.

B. Topsoil: Complying with plant material notes as indicated on the Drawings.

C. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   01 Type: Pine Straw
   02 Color: Natural
   03 Application: Four (4) inches thick

D. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:
   01 Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2 inch (50 mm) opening, 0.148 inch (3.76 mm) diameter wire chain-link fabric; with pipe posts, minimum 2 -318 inch (60 mm) OD line posts, and 2-718 inch (73 mm) OD comer and pull posts; with 1-518 inch (42 mm) OD top trails, with 0.177 inch (4.5 mm) diameter top tension wire and 0.177 inch (4.5 mm) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
   02 Height: 6 feet (1.8 m)
   03 Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm)

E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
   01 Size and Text: 18”x 24”
   02 Lettering: 3 inch (75 mm) high minimum, white characters on red background

2.2 IMPLEMENTATION

A. A 24” deep x 4” wide trench shall be cut 1’-0” in from the new concrete line, lined with polyurethane plastic sheeting and backfilled. Plastic should line both sides of trench and ends of plastic should be exposed to assure proper positioning. The trench is to protect the existing root system from damage. The plastic is to restrict leaching of lime to the roots during the lime stabilization process.

B. A temporary protective fence shall be installed completely around the existing trees to remain. The location of the protective fence shall be verified with Architect. The protected area shall not be used for any reasons, including material, vehicular, and equipment storage or vehicular traffic and parking.

C. A certified Arborist shall be contracted to trim trees in the protected area, and oversee and verify that the root systems have not been damaged during the construction process. The following is a list of locally approved Arborists:
   01 Champions Tree Services, Inc.
   02 Davey Tree Service
   03 Trees Incorporated

D. Trimming Operation:
   01 The Architect and Owner shall be notified of all trimming.
   02 Trees to be trimmed will include only trees affected by construction and those requiring maintenance in the preservation areas.
   03 Trees to be trimmed will be designated flagged in the field.
   04 Trees to be removed shall be designated by Architect.
   05 A list of the trees to be trimmed and the prescribed tree treatment will be provided by the Arborist.
   06 Trimming shall consist of the following methods:
      a. Class IV - Crown Reduction Pruning (reference National Arborist Association Standards for Pruning of Shade Trees 1988). Special trimming procedure to reduce crown of trees up to 30 percent, to prevent impact and stress of preservation trees. Corrective pruning and removal of all deadwood larger than 1 inch diameter will be required.
      b. Removal of all vines from trees.
      c. Removal of designated and or hazardous trees. All stumps shall be ground down 6 inches below grade.
      d. All chips produced from the trimming operation shall be left on site for Owner's use, unless otherwise directed. Chips will be blown onto or spread over preservation areas.
   07 All wood not chipped shall be hauled from site. No burning will be allowed on site.

E. Root Pruning Trenching Operation:
   01 Trenching areas shall be designated and exact locations will be marked in the field.
   02 Trenching depth shall be 2 foot minimum.
   03 Where excavation over 3 inches in depth is to occur within the root zone area of a preserve tree, make a clean cut (a minimum of 2 feet deep) between the designated disturbed and undisturbed root zone area, with a trenching machine, in order to minimize damage to the undisturbed root zone.
   04 Trench shall be backfilled and compacted immediately after trenching.

F. Tree Protection Fencing Installation:
   01 Tree protection fence - the exact locations will be marked in the field by the Architect.
   02 No access to fenced areas shall be permitted without prior approval by the Architect.
   03 Contractor shall provide maintenance and repair of fence during site work construction.
   04 Fence shall be removed after completion of site work construction, unless otherwise notified.

G. Fertilization Treatment:
   01 All preservation trees shall be treated, as designated by the Architect.
   02 Injection of a liquid mix of 50 percent Doggett XL Injecto feed and 50 percent "Maxicrop" into the root zone area of trees shall consist of the following method:
      a. Mix one pound of "Maxicrop" per 100 gallons water with Doggett XL Injecto Feed per label instructions in tank with agitation capability.
      b. Inject the mixture on a 3 foot square grid at 5 gallons per 100 square feet.
      c. Injection pressure shall be 100-150 psi as soil conditions warrant.
      d. Depth of injection will be 12 inches.

03 Mix approved wetting agent by label directions with mixture in order to provide better distribution and penetration of materials into soil.

H. Repair Operations:

01 If any damage to preservation trees should occur beyond what is expected during the construction period, the Architect and Arborist shall appraise the damage and order the repair by the Contractor or responsible party.

02 Trees lost due to contractor's negligence during the construction period shall be appraised by the Arborist and the Owner compensated or replacement trees provided.

2.3 REPAIR AND REPLACEMENT

A. The Contractor's photographic documentation of existing vegetation, plants and trees prior to start of Work shall be used to compare against condition vegetation, plants and trees at the conclusion of the Work.

B. The Contractor shall repair and / or replace all existing vegetation slated to remain that have been damaged as a result of Contractor activities.

C. Such repair and / or replacement shall restore vegetation, plants and trees to their original condition prior to start of Work at no expense to the Owner.

D. Replacement of vegetation, plants and trees shall be the same species and size of the original specimen.

E. All repairs and / or replacements shall be made at no additional cost to the Owner.

END OF SECTION

SECTION 01 57 10

TPDES REQUIREMENTS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 (the Construction General Permit).

B. Implementation, maintenance inspection, and termination 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 appropriate practices shown on the Drawings or specified elsewhere in the Contract.

C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with the Owner's Representative prior to start of construction.

1.2 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.

B. Large Construction Activity: Project that:

1. Disturbs five acres or more, or
2. Disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.

C. Small Construction Activity: Project that:

1. Disturbs one or more acres but less than five acres, or
2. Disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.

D. TPDES Operator:

1. The person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SWP3 for the site or other Construction General Permit conditions.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.1 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)

A. Prepare a SWP3 following Part III of the Construction General Permit and the applicable local code. If conflicts exist between the Construction General Permit and the local regulations, the more stringent requirements will apply.

B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.

C. Submit the SWP3 and any updates or revisions to the Owner's Representative for review and address comments prior to commencing, or continuing, construction activities.

3.2 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

A. Fill out, sign, and date TCEQ Form 20022 Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000).

B. Transmit the signed Contractor's copy of TCEQ Form 20022, along with a check for the required fee, made out to Texas Commission on Environmental Quality.

C. Submission of the Notice of Intent form by the Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

3.3 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice."

B. Transmit the signed Construction Site Notice to the Engineer at least seven days prior to Commencement of Construction Activity.

3.4 CERTIFICATION REQUIREMENTS

A. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form

3.5 RETENTION OF RECORDS

A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to the Owner's Representative.

3.6 REQUIRED NOTICES

A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. A signed copy of the Contractor's NOI must also be posted.

2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.
    a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with the Owner's Representative to conform to requirements of the Construction General Permit.
    b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.
4. Post a notice of waste disposal procedures in a readily visible location on site.

3.7 ON-SITE WASTE MATERIAL STORAGE

A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.

B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.

C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

3.8 NOTICE OF TERMINATION

A. Submit a NOT to TCEQ and the Engineer within 30 days after:

1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
2. Another operator has assumed control over all areas of the site that have not been stabilized; and
3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

END OF SECTION 01 57 10

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SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.

B. Protecting work against surface runoff and rising floodwaters.

C. Trapping suspended sediment in the discharge form the surface and ground water control systems.

PART 2 MEASUREMENT AND PAYMENT

2.1 UNIT PRICES

A. Measurement for control of ground water, if included in Bid Form, will be on either a lump sum basis or a linear foot basis for continuous installations of well points, eductor wells, or deep wells.

B. If not included in Bid Form, include the cost to control ground water in unit price for work requiring such controls.

C. No separate payment will be made for control of surface water. Include cost to control surface water in unit price for work requiring controls.

D. Follow Division 1 for unit price procedures.

E. Stipulated Price (Lump Sum) Contract. If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated Price.

2.2 REFERENCES

A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)

B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)

C. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

2.3 DEFINITIONS

A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.

1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel

excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.

B. Excavation drainage: includes keeping excavations free of surface and seepage water.

C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.

D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

2.4 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.

B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Division 2 to produce following results:

1. Effectively reduce hydrostatic pressure affecting:
   a. Excavations
   b. Tunnel excavation, face stability or seepage into tunnels
2. Develop substantially dry and stable subgrade for subsequent construction operations
3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work
4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata
5. Maintain stability of sides and bottom of excavations

C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas.

Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.

H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

2.5 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit Ground Water and Surface Water Control Plan for review by Owner's Representative prior to start of excavation work. Include the following:

1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control
2. Names of equipment Suppliers and installation Subcontractors
3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures
4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics
5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations
6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
7. Operating requirements, including piezometric control elevations for dewatering and depressurization
8. Excavation drainage methods including typical drainage layers, sump pump application and other means
9. Surface water control and drainage installations
10. Proposed methods and locations for disposing of removed water

C. Submit following records upon completion of initial installation:

1. Installation and development reports for well points, eductors, and deep wells
2. Installation reports and baseline readings for piezometers and monitoring wells
3. Baseline analytical test data of water from monitoring wells
4. Initial flow rates

D. Submit the following records weekly during control of ground and surface water operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.
2. Maintenance records for ground water control installations, piezometers and monitoring wells

2.6 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.

D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART 3 P R O D U C T S

3.1 EQUIPMENT AND MATERIALS

A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Owner's Representative through submittals required in Paragraph 1.06, Submittals.

B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate eductors, well points, or deep wells, when needed.

C. Maintain equipment in good repair and operating condition.

D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.

1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART 4 E X E C U T I O N

4.1 GROUND WATER CONTROL

A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Owner's Representative in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.

F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.

G. Removal of ground water control installations.

1. Remove pumping system components and piping when ground water control is no longer required.
2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor's use, upon completion of testing, as required in accordance with Part 3 of applicable specification.
3. Remove monitoring wells when directed by Owner's Representative.
4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hour after placement.

I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.

J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.

K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.

M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

4.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.

B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.

C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.

D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.06B.

4.3 SEDIMENT TRAPS

A. Install sediment tank as shown on approved plan.

B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

4.4 SEDIMENT SUMP PIT

A. Install sediment sump pits as shown on approved plan.

B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.

C. Extend standpipe 12 inches to 18 inches above lip of pit.

D. Convey discharge of water pumped from standpipe to sediment trapping device.

E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

4.5 EXCAVATION DRAINAGE

A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

4.6 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations.

D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Owner's Representative.

4.7 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Owner's Representative determines more frequent monitoring and recording are required. Comply with Owner's Representative's direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

4.8 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

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SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Division 1.

B. Installation and maintenance of storm-water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.

C. Filter Fabric Fences:

1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized flow areas.

D. Straw Bale Fence.

1.2 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. Payment for filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
2. Payment for reinforced filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.
4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.
5. Payment for storm-water-pollution-prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping includes diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.
6. Payment for straw bale barrier, if included in Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm-water-pollution-prevention structures.
7. Payment for brush berm, if included in Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm water-pollution-prevention structures.
8. Payment for sandbag barrier, if included in Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm-water-pollution prevention structures.
9. Payment for sediment basin with pipe outlet or stone outlet, if included in Bid Form, is on a square yard basis, if not include in cost of storm-water-pollution-prevention structures.
10. Payment for inlet protection barriers, if included in Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm-water-pollution prevention structures.
11. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCE STANDARDS

A. ASTM

1. A 36 - Standard Specification for Carbon Structural Steel.
2. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft3 (600 kN-m/m3)].
3. D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.4 SYSTEM DESCRIPTIONS

A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.

B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.

C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.

D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.

E. Sediment traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

1.5 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit manufacturer’s catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.

D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.

E. Submit shop drawings for Drop Inlet Baskets.

PART 2 P R O D U C T S

2.1 CONCRETE

A. Concrete: Class B in accordance with Division 32 or as shown on the Drawings.

2.2 AGREGATE MATERIALS

A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.

B. Provide gravel lining in accordance with Division 31 or as shown on the drawings.

C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.

D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.3 PIPE

A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Division 33 or as shown on the Drawings.

B. Inlet Pipes: Galvanized steel pipe in accordance with Division 33 or as shown on the Drawings.

C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.4 GEOTEXTILE FILTER FABRIC

A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.

B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.

C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.

D. Mirafi, Inc., Synthetic Industries, or equivalent.

2.5 FENCING

A. Wire Fencing: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.

B. Fence Stakes: Nominal 2 x 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

2.6 SANDBAGS

A. Provide woven material made of polypropylene, polyethylene, or polyamide material.

1. Minimum unit weight of four ounces per square yard.
2. Minimum grab strength of 100 psi in any principal direction (ASTM D4632).
3. Mullen burst strength exceeding 300 psi (ASTM D3786).
4. Ultraviolet stability exceeding 70 percent.
5. Size: Length: 18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: 50 to 125 pounds.

2.7 DROP INLET BASKET

A. Provide steel frame members in accordance with ASTM A36.

B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.8 STRAW BALE

A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.

B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

PART 3 E X E C U T I O N

3.1 PREPARATION, INSTALLATION AND MAINTENANCE

A. Provide erosion and sediment control structures at locations shown on the Drawings.

B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manger to remove and discard existing system.

D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Division 1.

E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Division 1.

F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Division 31.

G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.

H. Protect existing trees and plants in accordance with Division 1.

3.2 SEDIMENT TRAPS

A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.

B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.

C. Use fill material for embankment in accordance with Division 31.

D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.

E. Stone outlet sediment traps:

1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.
2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.

F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.

G. Remove sediment deposits when design basin volume is reduced by one-third or sediment level is one foot below principal spillway crest, whichever is less.

3.3 FILTER FABRIC FENCE CONSTRUCTION METHODS

A. Fence Type 1

1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory pre-assembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.
3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.
4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
5. Backfill and compact trench.

B. Fence Type 2

1. Layout fence same as for Type 1.
2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.
3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
4. Install trench same as for Type 1.
5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
7. Backfill and compact trench.

C. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.

D. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.

E. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

F. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.

G. Triangular Filter Fabric Fence Construction Methods

1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
2. Secure triangular fabric filter fence in place using one of the following methods:
   a. Toe-in skirt 6 inches with mechanically compacted material;
   b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or
   c. Trench-in entire structure 4 inches.
3. Anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.

H. Reinforced Filter Fabric Barrier Construction Methods

1. Attach woven wire fence to fence stakes.
2. Securely fasten filter fabric material to wire fence with tie wires.
3. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.
4. Remove sediment deposits when silt reaches depth one-third height of barrier or 6 inches, whichever is less.

3.4 DIKE AND SWALE

A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.

B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.

C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.

D. Clear in accordance with Division 31.

E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.5 DOWN SPOUT EXTENDER

A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Division 33.

3.6 PIPE SLOPE DRAIN

A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.

B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.

C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.

D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.

E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.7 PAVED FLUME

A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.

B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.

C. Construct permanent paved flumes in accordance with Drawings.

D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.8 LEVEL SPREADER

A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.

B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.9 INLET PROTECTION BARRIER

A. Place sandbags and filter fabric fences at locations shown on the SWP3.

3.10 DROP INLET BASKET CONSTRUCTION METHODS.

A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.

B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.

C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.

D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.11 STRAW BALE FENCE CONSTRUCTION METHODS

A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.

B. Embed bale in soil a minimum of 4 inches.

C. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.

D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.

E. Replace with new straw bale fence every two months or as required by Owner’s Representative.

3.12 BRUSH BERM CONSTRUCTION METHODS

A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.

B. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap. Avoid incorporation of annual weeds and soil into brush berm.

C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.

D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Division 1.

B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not water hose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.

B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.16 VEHICLE/ EQUIPMENT WASHING AREAS

A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Division 1. Install gravel or rock base beneath wash areas.

B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into watercourses or storm water conveyance systems.

C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.

B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.

C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.

E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.

F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1. Hold area of bare soil exposed at one time to a minimum.
2. Provide temporary controls such as berms, dikes, and drains.

G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.

H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.

I. Dispose of sediments offsite, not in or adjacent to streams or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.

J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.

K. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.

L. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Owner’s Representative.

B. Dispose of sediments and waste products following Division 1.

END OF SECTION 01 57 23

SECTION 01 74 16

SITE MAINTENANCE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Restoration of site affected by the Work in public or private property, including pavement, esplanades, sidewalks, driveways, fences, lawns and landscaping.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for restoration of Project site disturbed by utility construction operations is on a linear foot basis. Measurement will be as provided for corresponding utility in each Specification section. No separate payment made for branch pipe, valves and, other associated work for utilities. Measurement for restoration with multiple utilities within the same right-of-way will be on a linear foot basis for only one utility.
2. No separate payment made for facility or roadway projects. Include cost in the surface improvements associated with the facility or roadway construction.
3. Payment includes required site restoration within the right-of-way or easement regardless of size or type of pipe, method of construction, paved or unpaved areas or thickness and width of pavement.
4. No separate payment made for site restoration for service connections under this Section. Include cost in appropriate utility section.
5. Refer to Division 1 for Unit Price procedures.

B. Stipulated Price (Lump Sum) Contracts. If Contract is Stipulated Price Contract, include payment for work under this section in total Stipulated Price.

1.3 DEFINITIONS

A. Phase: Locations identified on the plans and listed in Division 1.

B. Site Restoration: Replacement or reconstruction of Site Improvements located in rights-of-way, easements, public property, and private property affected or altered by the Work.

C. Site Improvement: Includes pavement, curbs and gutters, esplanades, sidewalks, driveways, fences, lawns, irrigation systems, landscaping, and other improvements in existence at the Project site before commencement of construction operations.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Schedule of testing, service connections, abandonment, backfill, and site restoration.
C. Sample of notices to residents outlining their responsibility for maintenance of site improvements adjacent to the Project that are not disturbed by construction operations.

1.5 SCHEDULING

A. Schedule testing, service connections, abandonment, backfill and site restoration immediately following completion of pipe laying work or paving within each block or line segment.

B. Phased Construction:

1. Commencement of subsequent Phase will follow scheduling of site restoration of prior Phase. Limit work to a maximum of two Phases of the project.

C. Construction of Projects with no Phases listed in Division 1:

1. Complete site restoration prior to disturbing over 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way or easement.
2. Limit work to a maximum of 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way and easement. Commence work in additional right-of-way or easement after completion of site restoration.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Pavement, Sidewalks and Driveways: Materials specified in Division 32.

B. Seeding and Sodding: Sod specified in Division 32.

C. Trees, Shrubs and Plantings: Conform to requirements of Division 1.

PART 3 E X E C U T I O N

3.1 Preparatory Work

A. Provide cleanup and restoration crews to work closely behind pipe laying and roadway construction crews, and where necessary, during testing, service restoration, abandonment, backfill and surface restoration.

B. Water Lines: Unless otherwise approved by Owner's Representative, comply with the following:

1. Once Owner's Representative approves work within a Phase, immediately begin preparatory work for disinfection effort.
2. No later than three days after completing disinfection preparatory work, initiate disinfection work.
3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.

C. Wastewater Lines:

1. Once Owner's Representative approves work within a Line Segment, immediately begin preparatory work for testing effort.
2. No later than three days after completing preparatory work for testing, initiate testing work.
3. Immediately after transfer of service connections, begin abandonment of old wastewater lines, and site restoration.

D. Street Construction and Paving Projects

1. Once Owner's Representative approves work within a Line Segment or block, immediately begin preparatory work for testing effort.
2. No later than three days after completing preparatory work for testing, initiate testing work.
3. Immediately after testing begin site restoration.

E. Street Construction and Paving Projects

1. Once Owner's Representative approves work within a block, immediately begin preparatory work for sidewalk construction, sodding and hydromulching and tree planting.
2. No later than seven days after completing preparatory work, initiate construction.

3.2 CLEANING

A. Remove debris and trash to maintain a clean and orderly site in accordance with requirements of General Conditions and Division 1.

3.3 LANDSCAPING AND FENCES

A. Seeding and Sodding.

1. Remove construction debris and level area with bank sand so that new grass surface matches level of existing grass and maintains pre-construction drainage patterns. Level and fill minor ruts or depressions caused by construction operations with bank sand, where grass is still viable.
2. Restore previously existing turfed areas with sod and fertilize in accordance with Division 32. Sod to match existing turf.
3. Restore unpaved areas not requiring sodding with hydromulch seeding conforming to Division 32.

B. Trees, Shrubbery and Plants.

1. Remove and replant trees, shrubs, and plants in accordance with requirements of Division 1.

C. Fence Replacement.

1. Replace removed or damaged fencing to equal or better condition than existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing and panels. Metal fencing material, not damaged by the Work, may be reused.
2. Remove and dispose of damaged or substandard material.

3.4 MAINTENANCE

A. Maintain shrubs, plantings, sodded areas and seeded areas.

B. Replace shrubs, plantings and seeded or sodded areas that fail to become established.

C. Refer to Division 1 for maintenance requirements.

END OF SECTION 01 74 16

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.2 SUBMITTALS

A. Conform to requirements of Division 1.

B. Contractor shall obtain all required permits prior to disposal of excess material in areas designated as being in "100-year Flood Hazard Area."

C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.

D. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit written and signed release from property owner upon completion of disposal work.

E. Describe waste materials expected to be stored on-site and a description of controls to reduce Pollutants from these materials, including storage practices to minimize exposure of materials to storm water; and spill prevention and response measures in the Project's Storm Water Pollution Prevention Plan (SWPPP). Refer to Division 1.

PART 2 P R O D U C T S -Not Used

PART 3 E X E C U T I O N

3.1 SALVAGEABLE MATERIAL

A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.

B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material designated for salvage into Owner's designated trucks.

C. Pipe Culvert: Load culverts designated for salvage into Owner's designated trucks.

D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.

E. Coordinate loading of salvageable material on Owner's trucks with Owner's Representative.

F. The Contractor shall dispose of all items the Owner refuses in conformance with the requirements of Division 1 at no additional cost to the Owner.

3.2 EXCESS MATERIAL

A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.

B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner. See Paragraph 1.02 D above.

C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless a permit has been obtained. Remove excess material placed in "100-year Flood Hazard Area" without a permit, at no additional cost to the Owner.

D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

END OF SECTION 01 74 19

SECTION 01 77 00

CLOSE-OUT PROCEDURES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Certain procedures have been developed and are required to fulfill all provisions of the Owner-Contractor Agreement with respect to contract Final Completion and Contract Close-Out for the Work / project to be 100% complete.

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. The Architect shall provide a Close-Out spreadsheet guide to the Contractor for use in monitoring progress of contract Close-Out documentation.
   01 The Contractor shall review the Close-Out spreadsheet guide and revise as necessary to include all Close-Out requirements.
   02 Coordinate with the Architect on proposed revisions and finalization of the Close-Out spreadsheet guide

C. The Contractor shall introduce a Close-Out agenda item on the weekly / bi-weekly progress meeting agenda a minimum of 3 months prior to substantial completion date.
   01 Contractor shall report on contract Close-Out status and progress at each meeting.

D. Operation and Maintenance (O&M) manuals required in the Specifications shall be submitted for review and acceptance by the A/E consultants prior to the Contractor conducting any required Owner training.
   01 The Contractor shall allow sufficient time for A/E review, including, but limited to A/E requirements for revisions and resubmission of O&M manuals.

E. Close-Out documentation shall be submitted as described in this section. Refer to Part 2 and Part 3.

1.3 QUALITY ASSURANCE

A. Completing and submitting complete and correct Close-Out documentation is the sole responsibility of the Contractor.
   01 Unless otherwise agreed upon by the Architect, partial submission of Close-Out documentation is not permitted.

B. The Contractor shall use all QA / QC means necessary to assure that upon submission Close-Out documentation is complete and correct PRIOR to submission to Architect for review.

C. Submission of Close-Out documentation shall be accompanied by Architect provided Close-Out spread sheet.
   01 Contractor shall submit Close-Out spreadsheet with each required item initialed by Contractor signifying each item has been verified to be complete and correct.
   02 Failure to submit completed Close-Out spreadsheet shall result in no review of Close-Out documentation by the Architect and return of all Close-Out documentation to the Contractor.

D. It is not the Architect's responsibility to review incomplete and / or incorrect Close-Out documents; nor is it the Architect's responsibility to provide the Contractor a list of missing or incorrect Close-Out documents.

E. Upon Contractor's submission of Close-Out documents / binders, the Architect shall review the submission.
   01 If the Architect discovers any incomplete or missing documents, the Architect's review shall promptly end without further review and the Contractor shall be notified to retrieve the documents for further action on their part to assure completeness and correctness of Close-Out documents.

PART 2 – SUBSTANTIAL COMPLETION

2.1 GENERAL

A. Projects that involve phased sequential construction of major definable areas or projects that involve separate work on multiple campuses shall have Certificates of Substantial Completion issued for each phase or campus, as applicable and agreed upon by the Owner and Contractor.
   01 All conditions for Substantial Completion, including liquidated damages, shall apply for each date of Substantial Completion for each phase or campus, as applicable.

B. Individual Substantial Completion Dates for each phase or campus shall be determined and agreed upon by the Owner, Architect and Contractor.
   01 Where an Alternative Proposal dictating a required, guaranteed completion date (dates) is included in the Proposal Form and accepted by the Owner, the date(s) stated therein shall establish the Substantial Completion Dates to be incorporated into the Agreement.

C. The following items are a partial list of requirements, as applicable to the Project, which must be completed prior to establishment of a Substantial Completion date.
   01 All work as identified in each section of the Specifications must be 100% complete.
   02 Contractor's punch list, including supplementing items by A/E team and Owner must be fully documented.
   03 All fire alarm system components must be completed, demonstrated to the Owner and approved by the governing authority.
   04 Local fire marshal approval certificate must be delivered to the Owner.

05 Health Department approval and certificate must be delivered to Owner.
06 All HVAC air and water balancing must be complete.
07 All energy management systems, security and surveillance systems and low voltage systems and controls must be complete, fully operational and demonstrated to the Owner.
08 All final lockset cores must be installed, and all final Owner directed keying completed.
09 All room plaques and exterior signage must be complete.
10 Operation and Maintenance manuals must be submitted, reviewed, accepted and delivered to Owner prior to Owner training and orientations of equipment and systems.
11 All Owner demonstrations must be completed.
12 A final Certificate of Occupancy must be signed by the governing authority and delivered to the Owner.
13 Municipal Utility District / County approvals and compliance certificates must be delivered to the Owner.
14 Scanned record drawings. Provide a full size, scanned copy of the record drawings maintained at the site in PDF format.
15 All exterior clean-up and landscaping must be complete, including required stand of grass mowed and edged.

D. Final Cleaning:
01 The work area shall be thoroughly cleaned inside and outside. Cleaning includes removal of smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces.
02 Remove all temporary facilities.

E. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.
01 Upon such acceptance and consent of surety, if any, the Owner, at his sole discretion, may make partial payment of retainage applying to such Work or designated portion thereof which is 100% complete and accepted by the Owner.
02 Such payment, if made at all, shall be adjusted in the Owner's favor for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

F. The date of Substantial Completion shall represent day one (1) of the thirty (30) day period to complete all work and correct all deficiencies contained in the Punch List and the sixty (60) day period allowed for complete Contract Close-Out as described below.

2.2 PUNCH LIST

A. Refer to Section 01 31 00 – Project Management Software for information regarding the use of the Contractor provided punch software in development and processing the punch list.

B. Per the Contract, a final, comprehensive punch-list is required to be attached to the Substantial Completion Certificate.
01 The punch list shall be a comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be corrected, or limited items of work to be completed, if any.

02 Prior to the Contractor drafting the punch list, all subcontractors should thoroughly review their work and correct the work to preclude its inclusion on a punch list.

03 This list is intended to represent a limited number of items needing attention.

C. It is the Contractor's responsibility to produce the initial punch list and provide training and access to the Contractor provided software program for the A/E Consultants and Owner for supplementation.

01 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 revisions.

02 The Architect, and Owner at his discretion, shall supplement the Contractor's punch list as necessary to be a comprehensive, complete list of all work items needing attention for Owner's final acceptance of the work.

03 The date of Substantial Completion will be delayed until the punch list is fully compiled and finalized by the Architect.

D. All punch list shall be developed using the Contractor provided punch software program. The software program is required to be an application to describe punch list items with the ability to utilize floor plan and photo inserts to better delineate the punch list item.

01 The Contractor provided punch list software program must include the equipment needed for the A/E Consultants and Owner to supplement their items to the Contractor's initial punch list.

02 The Contractor shall provide training to the A/E Consultants and Owner for using the Contractor provided punch software program.

E. The information to be filled in includes the following:

01 Item Number: auto assigned by the punch software program
02 Contract Document Room Number
03 Building Room Number
04 Walk-Thru Date
05 Author of item
06 Subcontractor Responsibility: populated by GC only
07 Item Category: obtained from a drop down menu
08 Item Description: obtained from a drop down menu
09 Comments
10 Subcontractor Completion Sign-Off
11 GC Completion Sign-Off
12 A/E Consultants Sign-Off
13 Floor Plan Insert
14 Photo Insert

F. 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 / subcontractor to thoroughly examine the entire project and make corrective measures at all applicable locations.

G. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion.

01 The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.

02 The Contractor is encouraged to generate unofficial, individual trade punch lists.

H. 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.

01 The Superintendent shall record or otherwise take note of all supplementary items.

02 The A/E Consultants will endeavor to furnish to the Contractor supplements to the Contractor's punch list software 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 note the supplementation on the Contractor's punch list software.

2.3 OPERATIONS AND MAINTENANCE OWNER DEMONSTRATIONS

A. Refer to Section 01 78 23 – Operation and Maintenance Manuals.

B. Specific specification sections require the Contractor to provide training to the Owner regarding proper operation and maintenance of specific products and / or assemblies.

C. Successful completion of all Owner operation and maintenance training demonstrations is a prerequisite to achieving Substantial Completion.

D. No Owner operation and maintenance training demonstrations shall occur prior to delivery of final, accepted operations and maintenance manuals to the Owner.

E. Manuals shall be delivered to the Owner prior to Owner training and demonstrations to allow the Owner the benefit of having the manuals for on-site training and start-up procedures provided by the Contractor.

F. Deliverables:

01 Provide one (1) electronic copy of all O&M manuals for review by the respective discipline. Deliver A/E Consultant O&M Manuals directly to the relative A/E Consultant with a copy of the transmittal to the Architect.

02 Resubmit as necessary to obtain final acceptance of Manuals.

03 Once all corrections have been made and the O&M Manuals found to be acceptable, provide one (1) hard copies of each binder and two (2) PDF format electronic copies (Thumb drives) of each binder to the Architect for transfer to the Owner. The GC sheall additionally upload the O&M documents into the appropriate Projectmates folder.

2.4 SUBSTANTIAL COMPLETION SCHEDULE

A. After the date of Substantial Completion of the project as evidenced by the Certificate of Substantial Completion, AIA document G704-2000, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to complete all work and correct all deficiencies contained in the Punch List attached to the Certificate of Substantial Completion. It is incumbent upon the Contractor to request Substantial

Completion only when there is assurance that all work included on the Punch List shall be completed within the thirty (30) daytime frame.

01 In the event the Owner must take occupancy of the project prior to Contractor's completion of the punch list, the Contractor shall make all adjustments necessary to schedule the work to allow full and normal operation of the project by the Owner.

02 Where this requires work outside of normal business hours, the work shall be provided at no additional costs to the Owner.

B. Upon Contractor's and sub-contractor's verification that all punch list items have been 100% completed, the Contractor shall notify the Architect and the Architect and consultant(s) shall conduct an on-site observation to verify that all items are 100% complete.

01 On-site verifications for partial completions, if any, shall be conducted by the Architect at the Architect's sole discretion.

02 If any items shown to be complete by the Contractor are found not to be complete by the Architect, the observation shall be stopped, with such notification to the Contractor.

03 Contractor's requested punch list observations by the Architect shall be limited to a maximum of two (2) per punch list.

C. If the Contractor fails to complete all work on the punch list within thirty (30) days after the Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the punch list items are competed and accepted by the Owner. During this time the Contractor will be charged from the Owner's, Architect's and any A/E Consultant's time associated with achieving completion of the punch list.

01 Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.

02 The weekly meetings shall include a minimum of two (2) hours charge per participant.

D. Owner billable time shall be deducted from the Contractor's Final Payment or separately invoiced to the Contractor at Owner's option. Owner billable hourly rates shall be as follows:

01	A/E Principal:	$250.00 per hour
02	Project Manager:	$150.00 per hour
03	Project Coordinator:	$125.00 per hour
04	Administration / Secretarial:	$80.00 per hour

E. Architect and A/E Consultant billable time shall be invoiced to the Contractor by the Architect. A/E billable rates shall be as follows:

01	A/E Principal:	$250.00 per hour
02	A/E Project Manager:	$150.00 per hour
03	Staff Architect / Consultant:	$125.00 per hour
04	A/E Field Representative	$125.00 per hour
05	Administration / Secretarial:	$80.00 per hour

PART 3 – CONTRACT CLOSE-OUT

3.1 GENERAL

A. Upon issuance of the (final) Certificate of Substantial Completion, and per the Owner-Contractor Agreement, the Contractor will be allowed a period of sixty (60) days within which to complete all Contract Close-Out requirements, unless extended by mutual agreement or provision of the Contract.

B. In addition to all work and requirements described for Substantial Completion, to achieve Contract Close-Out, the Contractor shall submit the following Close-Out documents in 3-ring binders in the following format:

01 Tab 1: Copy of executed Certificate of Substantial Completion. And copy of all final punch lists showing final approval / acceptance of each item by sub-contractor, Contractor, and Architect / Architect's Consultant.

02 Tab 2: Copy of all building permits.

03 Tab 3: Copy of all Certificates of Occupancy and final approvals of authorities having jurisdiction.

04 Tab 4:

a. Final list of sub-contractors - **alphabetical** listing. List shall contain company name, address, phone number, contact person, relative specification section number, and description of work provided.

b. Final list of sub-contractors - **numerical** specification section number listing. List shall contain company name, address, phone number, contact person, and description of work provided.

05 Tab 5:

a. AIA G707-1994 Consent of Surety to Final Payment. Must be notarized. (Note: Architect shall provide standardized form to be used.)

b. AIA G706-1994 Contractor's Affidavit of Payment of Debts and Claims. Must be notarized. (Note: Architect shall provide standardized form to be used.)

06 Tab 6: AIA G706A-1994 Contractor's Affidavit of Release of Liens. Must be notarized. (Note: Architect shall provide standardized form to be used.)

07 Tab 7: Contractor's written one (1) year warranty / guarantee. Must be notarized. (Note: Architect shall provide standardized form to be used.)

08 Tab 8: Contractor's Affidavit of Hazardous Material. Must be notarized. (Note: Architect shall provide standardized form to be used.)

09 Tab 9:

a. Finish Floor Elevation Certificate from a registered Land Surveyor; if required by the local jurisdiction having authority.

b. As-built survey of detention pond from a registered Land Surveyor to certify the detention pond was constructed in accordance with the permitted design; if required by the local jurisdiction having authority.

10 Tab 10: Subcontractors' / Material / Equipment Suppliers Affidavit of Release of Liens. Must be notarized. (Note: Architect shall provide standardized form to be used.)

11 Tab 11: Subcontractors' written warranty / guarantee required in excess of one (1) year. Must be notarized. (Note: Architect shall provide standardized form to be used.)

12 Tab 12: Subcontractors' and suppliers Affidavits stating that no asbestos or hazardous material products have been installed in this project. Must be notarized. (Note: Architect shall provide standardized form to be used.)

13 Tab 13: Manufacturer's written warranties to the Owner for each product / assembly / system warranty required in individual specification sections. Organize and identify each manufacturer's written warranty (top right-hand corner) by subcontractor's name - in alphabetical order; and identify with the corresponding specification section number – scope of work.

14 Tab 14: If asbestos abatement was performed, provide a copy of all applicable governmental forms, final test reports and certifications.

15 Tab 15: Owner demonstration and / or training verification. Provide sign-in sheet for all demonstrations and training sessions conducted for the Owner.

16 Tab 16: Extra stock verifications of product delivery to Owner.

C. Record Drawings. Refer to section 3.4 below. Record Drawings shall be submitted separately from Close-Out binders / manuals.

D. Owner's set of record, final submittals. Refer to section 3.5 below. Record Submittals shall be submitted separately from Close-Out binders / manuals.

E. Final / 100% release of retainage will not be authorized by the Architect until the Contractor completes all of the requirements for Contract Close-Out; and until all expenses incurred and to be paid by the Contractor have been paid in full.

F. It is the Contractor's sole responsibility prior to submission to verify that Close-Out documents proposed to be furnished for review and acceptance are 100% complete and accurate.

01 If during review the Architect or Engineer determines the Close-Out documents are incomplete and / or inaccurate, the review shall cease and the Contractor shall be so notified to retrieve the Close-Out Documents, make corrections and resubmit.

02 It is not the A/E Consultants' responsibility to return a list of missing and / or incorrect items.

G. It is desirable and beneficial to submit all Close-Out documents as a single submission; Close-Out documents may be submitted separately in four (4) deliverables as follows:

01 Close-Out Manual

02 Operations and Maintenance Manuals (required prior to Substantial Completion)

03 Record Drawings

04 Owner's Record Copy of Submittals

3.2 CLOSE-OUT MANUAL(S) FORMAT

A. All Close-Out documents shall be submitted in three ring binders with detailed table of contents and index tabs corresponding to the table of contents.

01 Documents shall be separated by tabs as indicated in Paragraph 3.1 above.

02 The Close-Out documents must be neatly organized and easily useable, as determined by the Architect and Owner.

03 Each binder shall include an insert cover with the following information

a. Project name

b. Binder Title: Close-Out Manual - "description"

c. Architect's name

d. Architect's project number

e. Contractor's name, address and phone number

04 Each binder shall include an insert in the binder spine with the following information
   a. Project name
   b. Binder Title: Close-Out Manual - "description"

05 Inside cover page containing the following:
   a. Project name
   b. Contractor's address and contact information
   c. Contractor's project manager and superintendent name and contact information.
   d. Architect's project manager name and contact information.
   e. Each consultant's project manager name and contact information.

06 Table of Contents and corresponding section tabs shall be in the same order as described in section 3.1-B above.

07 Provide one (1) bound copy of the Close-Out documents binder for review by the Architect. No electronic or PDF copies to be provided until final acceptance of all binders.

08 Resubmit as necessary to obtain final acceptance of Close-Out documents binder.

09 Once all corrections have been made and the Close-Out documents binder is found to be acceptable, provide final copies to the Architect for transfer to the Owner.

10 Number of binders required: one (1).

11 Number of flash drive with electronic format required: two (2).

3.3 WARRANTIES

A. All guarantees and warranties required by the Contract Documents shall establish the date of Substantial Completion as day one (1) of the required warranty period; regardless of how long the product, assembly or work has been installed or in operation prior to Substantial Completion.

   01 Coordinate with subcontractors and material suppliers to account for provision in their original proposal / bid amount, if necessary.

B. Contractor's One-Year Warranty: The Contract requires the General Contractor to warrant ALL materials and work provided / furnished for a period of one (1) year following the date of Substantial Completion.

   01 The one year general warranty shall include all labor, material and delivery costs required to correct defective material or installation during the Warranty period.

C. Extended Warranties: In addition to the General Contractor's, other required guarantees and warranties in excess of one year shall be included in the Close-Out Binder in original issue form. All extended warranties shall begin on the Substantial Completion date; and shall include all labor, material and delivery costs required to correct defective material or installation. Guarantees include but are not limited to:

   01 Section 04 20 00 – Unit Masonry – 2 years
   02 Section 04 20 00 – Masonry Water Repellant – 5 years
   03 Section 07 52 50– Roofing – 20 years No Dollar Limit Total / Non-Prorated Systems Warranty
   04 Section 07 25 00 – Weather Barrier – 10 years (material / manufacturer) / 2 year labor (installer)

05 Section 07 41 13 – Metal Roofing and Wall Panels – 20 years on factory finish
06 Section 07 41 13 – Metal Roofing Water-tightness – 20 years
07 Section 07 42 13 – Metal Wall Panels – 20 years on factory finish
08 Section 07 92 00 – Sealants – 2 years
09 Section 08 14 23.16 – Plastic-Faced Wood Doors – life of the doors
10 Section 08 80 00 – Glazing – 5 years
11 Section 09 30 13 – Ceramic Tile System – 10 years
12 Section 09 68 19 – Carpeting – 15 years, life for static
13 Section 09 72 13 – Digital Wall Covering – 5 years
14 Section 09 91 00 – Painting – 2 years
15 Section 10 44 00 – Toilet Accessories – 2 years for stainless steel finish
16 Section 10 51 13 – Metal Lockers – 2 years standard lockers / 10 year athletic lockers
17 Division 22 – Plumbing Systems – as specified
18 Division 23 – Mechanical Systems – as specified
19 Division 26 – Electrical Systems – as specified

3.4 RECORD DRAWINGS

A. Upon Substantial Completion, the Contractor shall be furnished, at no charge, a complete set of electronic files in AutoCAD release 2010 or later, or Revit if applicable, of all drawings included in the Contract Documents. The title blocks shall be stripped of all logos, disclaimers and licensed seals of the Architect and Consultants.
   01 Applicable CTB or plot files shall be furnished by the Architect and each Consultant.
   02 Throughout the construction phase, Architect's and Consultant's supplemental drawings / sketches provided to the Contractor in AutoCAD or Revit format shall already be incorporated in the electronic files provided to the Contractor.

B. Upon request, the Architect and / or Consultants shall assist the Contractor with understanding the structure and composition of the electronic files to facilitate the generation of the Record Drawings.

C. The Contractor shall modify the title block on each / every sheet to include only the project name, project address, school district, consultants' name and address, date, and clearly identify the set as "Record Drawings".

D. All electronic Record Drawing work shall be performed in a professional manner using AutoCAD or Revit, as applicable, and shall maintain the format / structure / composition of the original Contract Document Drawings.

E. All modifications, additions, deletions and revisions made to the project during the construction phase shall be reflected on the Record Drawings; and shall include, but not necessarily limited to:
   01 All as-built dimensions (different than original dimensions)
   02 All as-built locations and conditions relative to underground plumbing, sanitary and storm piping installations, natural gas piping and electrical conduits; shown accurately to within twelve inches (12"). Notes shall indicate approximate depth of all underground piping and utilities.
   03 All as-built conditions relative to ductwork installations; shown accurately to within six inches (6").

04 All as-built conditions relative to HVAC water piping installations; shown accurately to within six inches (6”).
05 All as-built conditions relative to underground electrical conduit installations; shown accurately to within six inches (6”).
06 Record drawings shall include a copy of fire sprinkler layout of piping and equipment.
07 All approved CPR’s resulting in a physical change in the Work.
08 All RFI’s resulting in a physical change in the Work.
09 All AEA’s resulting in a physical change in the Work.
10 All Minor Changes resulting in a physical change in the Work.
11 All Construction Change Directives resulting in a physical change in the Work.
12 Update the list of drawings as necessary to reflect added and deleted sheets.

F. All modifications shall be represented by actually deleting the original work and accurately depicting the revised as-built modifications / configurations. “X-ing out” deleted work shall not be accepted

G. Provide the Record Drawings with all revision clouds and other change identifiers removed.

H. Upon completion of all revisions to the Record Drawings, including the Architect’s acceptance, the Record Drawings shall be copied to a flash drive maintaining the exact folder / file structure originally furnished to the Contractor. Submit to the Architect for review before proceeding with deliverables.

I. Deliverables: Upon review and acceptance of the documentation, including format, the Architect shall direct the Contractor to proceed with delivery of the following:
01 Two (2) flash drives containing the entire set of Record Drawings in PDF format. Each sheet shall be a separate PDF file. The electronic files shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with Record Drawing modifications.
02 Two (2) flash drives containing the entire set of Record Drawings in AutoCAD or Revit format as applicable. Each sheet shall be a separate AutoCAD or Revit file. The electronic files shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with Record Drawing modifications.
03 One (1) full-size, complete set of black-line copies on minimum 20 lb. bond paper. The set shall be plotted using the Contractor’s flash drives to assure the files plot correctly. The set shall be screw-post bound.
04 One (1) half-size, complete set of black-line copies on minimum 20 lb. bond paper. The set shall be plotted using the Contractor’s flash drives to assure the files plot correctly. The set shall be screw-post bound.

3.5 RECORD SUBMITTALS

A. The Contractor shall maintain and submit a separate set of final submittals to be delivered to the Owner as a condition of Contract Close-Out.

B. Include only the final version of each submittal, including all submittal review comment sheets from the Architect and Consultant. Versions of submittals that were rejected or required to be revised and resubmitted are not required.

C. Deliverables:
   01 Deliver one (1) hard copy set of Record Submittals in file boxes, organized in order by specification division, with tabs included for each section of specifications.
   02 Deliver two (2) copies of all Record Submittals in PDF electronic format on two (2) digital storage devices, including a copy of the Contractor's Submittal Log.

3.6 CONTRACT CLOSE-OUT SCHEDULE

A. If the Contractor fails to complete requirements of Contract Close-Out within sixty (60) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the Close-Out documents are completed and accepted by the Owner. During this time the Contractor will be charged for the Owner's, Architect's and any A/E Consultant's time associated with achieving Final Completion.
   01 Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
   02 The weekly meetings shall include a minimum of two (2) hours charge per participant.

B. Owner billable time shall be deducted from the Contractor's Final Payment or separately invoiced to the Contractor at Owner's option. Owner billable hourly rates shall be as follows:

01	A/E Principal:	$250.00 per hour
02	Project Manager:	$150.00 per hour
03	Project Coordinator:	$125.00 per hour
04	Administration / Secretarial:	$80.00 per hour

C. Architect and A/E Consultant billable time shall be invoiced to the Contractor by the Architect. A/E billable rates shall be as follows:

01	A/E Principal:	$250.00 per hour
02	A/E Project Manager:	$150.00 per hour
03	Staff Architect / Consultant:	$125.00 per hour
04	A/E Field Representative	$125.00 per hour
05	Administration / Secretarial:	$80.00 per hour

D. In scheduling submission(s) and final approvals of Close-Out documents, the Contractor shall allow for the following review period for each submission:
   01 Architect: Ten (10) calendar days
   02 Architect's Consultant: Twelve (12) calendar days.

E. Additionally, failure by the Contractor to complete Contract Close-Out within the stipulated time will be reported to the Contractor's surety. In the report of deficiency, the Contractor and surety will be informed that, should correction work remain incomplete for fifteen (15) additional days, the Owner at his discretion may initiate action to complete corrective work out of the remaining contract funds in accordance with the Owner-Contractor Agreement, General and Supplementary Conditions to the Agreement as they apply.
   01 Additional costs of the Owner, Architect, and other consultants incurred because of the Contractor's failure to complete Contract Close-Out within sixty (60) days after the date of Substantial Completion, unless extended by mutual agreement or provision of the contract, will be deducted from the funds remaining to be paid to the Contractor.

3.7 TERMINAL INSPECTION

A. Approximately one (1) month prior to expiration of the one-year guarantee period, the Contractor shall notify the Architect and Owner to schedule 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 though the date of completion of the corrective work may extend beyond the expiration date of the guarantee 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.

END OF SECTION

AIA® Document G707™ – 1994

Consent Of Surety to Final Payment

PROJECT: *(Name and address)*	**ARCHITECT'S PROJECT NUMBER:**	OWNER: ☐
	CONTRACT FOR:	ARCHITECT: ☐
		CONTRACTOR: ☐
TO OWNER: *(Name and address)*	**CONTRACT DATED:**	SURETY: ☐
		OTHER: ☐

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the
(Insert name and address of Surety)

, SURETY,

on bond of
(Insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety of any of its obligations to
(Insert name and address of Owner)

, OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:
(Insert in writing the month followed by the numeric date and year.)

_____
(Surety)

_____
(Signature of authorized representative)

Attest:
(Seal):

_____
(Printed name and title)

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AIA® Document G706™ – 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: *(Name and address)*	**ARCHITECT'S PROJECT NUMBER:**	OWNER: ☐ ARCHITECT: ☐
	CONTRACT FOR:	CONTRACTOR: ☐
TO OWNER: *(Name and address)*	**CONTRACT DATED:**	SURETY: ☐ OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment ☐ Yes ☒ No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.
3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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User Notes: (1983279481)

AIA® Document G706A™ – 1994

Contractor's Affidavit of Release of Liens

PROJECT: *(Name and address)*	**ARCHITECT'S PROJECT NUMBER:**	OWNER: ☐
		ARCHITECT: ☐
	CONTRACT FOR: General Construction	CONTRACTOR: ☐
TO OWNER: *(Name and address)*	**CONTRACT DATED:**	SURETY: ☐
		OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: *(Name and address)*

BY:

_____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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SUBCONTRACTOR / SUPPLIER AFFIDAVIT AND RELEASE OF LIEN
"Unconditional Affidavit"

STATE OF _____

COUNTY OF _____

PROJECT: WEST AGRICULTURAL SCEINCE FACILITY

OWNER: TOMBALL ISD

ARCHITECT: Arcadis Inc.

KNOW ALL MEN BY THESE PRESENTS:

_____ , being first duly sworn, disposes and says:

1. That he/she is the _____of _____the subcontractor/supplier who supplied, installed, and/or erected the work described below, and that, he is duly authorized to make this Subcontractor/Supplier Affidavit and Release of Lien:

Work Performed: _____

Specification Section(s): _____

2. That all work required under the subject subcontract or purchase order 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 contract which have not been paid and satisfied in full.
3. That to the best of his 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 contract, 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 has received full payment of all sums due him for materials furnished and services rendered by the undersigned in connection with the performance of said contract 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 contract.

ATTEST (If Corporation)

_____
Name of Subcontractor / Supplier

_____ _____ _____
Secretary By Date

Subscribed and sworn to before me on this _____day of _____, 20_____.

Notary Public: _____

My Commission Expires: _____

GENERAL CONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

PROJECT: WEST AGRICULTURAL SCIENCE FACILITY

OWNER: TOMBALL ISD

ARCHITECT: Arcadis Inc.

KNOW ALL MEN BY THESE PRESENTS:

_____ , being first duly sworn, disposes and says:

1. That he/she is the _____of _____the contractor who constructed the project referenced above, and that, he is duly authorized to make this General Contractor Warranty.
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 Contractor's warranty excludes remedy from damage or defect caused by abuse, modifications not executed by the Contractor, 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 Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Owner or Architect.
4. The Contractor warrants the entire project for a period of twelve (12) months from the Date of Substantial Completion and specific sections of work for such additional periods as enumerated in the Contract Documents, except as follows:

_____

_____

_____

ATTEST (If Corporation)

_____
Name of Contractor

_____ _____ _____
Secretary By Date

Subscribed and sworn to before me on this _____day of _____, 20_____.

Notary Public: _____

My Commission Expires: _____

SUBCONTRACTOR GUARANTEE/WARRANTY

STATE OF _____

COUNTY OF _____

PROJECT: WEST AGRICULTURAL SCIENCE FACILITY

OWNER: TOMBALL ISD

ARCHITECT: Arcadis Inc.

KNOW ALL MEN BY THESE PRESENTS:

_____ , being first duly sworn, disposes and says:

1. That he/she is the _____of _____the subcontractor who supplied, installed, and/or erected the work described below, and that, he is duly authorized to make this Subcontractor Warranty:

Work Performed: _____

Specification Section(s): _____

2. The undersigned Subcontractor 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 from 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 Contractor 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 Date

Subscribed and sworn to before me on this _____day of _____, 20_____.

Notary Public: _____

My Commission Expires: _____

CONTRACTOR / SUPPLIER HAZARDOUS MATERIAL CERTIFICATE

STATE OF _____

COUNTY OF _____

PROJECT: WEST AGRICULTURAL SCIENCE FACILITY

OWNER: TOMBALL ISD

ARCHITECT: Arcadis Inc.

KNOW ALL MEN BY THESE PRESENTS:

_____ , being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the General Contractor who constructed or provided the sections of work described below, and that, he is duly authorized to make this Certification.

   Work Performed: _____

   Specification Section(s): _____

2. Do hereby certify that to the best of his information, knowledge, and belief, no asbestos, materials containing asbestos or polychlorinated biphenyl (PCB) have been used or incorporated into the Work; and that no lead or lead bearing materials have been used or incorporated into the potable water systems of the Work during the construction of the above referenced project.

ATTEST (If Corporation)

_____
Name of General Contractor

_____ _____ _____

Secretary By Date

Subscribed and sworn to before me on this _____day of _____, 20_____.

Notary Public: _____

My Commission Expires: _____

SUBCONTRACTOR / SUPPLIER HAZARDOUS MATERIAL CERTIFICATE

STATE OF _____

COUNTY OF _____

PROJECT: WEST AGRICULTURAL SCIENCE FACILITY

OWNER: TOMBALL ISD

ARCHITECT: Arcadis Inc.

KNOW ALL MEN BY THESE PRESENTS:

_____ , being first duly sworn, disposes and says:

1. That he/she is the _____of _____the subcontractor who constructed or provided the sections of work described below, and that, he is duly authorized to make this Certification:

Work Performed: _____

Specification Section(s): _____

2. Do hereby certify that to the best of his information, knowledge, and belief, no asbestos, materials containing asbestos or polychlorinated biphenyl (PCB) have been used or incorporated into the Work; and that no lead or lead bearing materials have been used or incorporated into the potable water systems of the Work during the construction of the above referenced project.

ATTEST (If Corporation)

_____
Name of General Contractor

_____ _____ _____

Secretary By Date

Subscribed and sworn to before me on this _____day of _____, 20_____.

Notary Public: _____

My Commission Expires: _____

SECTION 01 78 23

OPERATING AND MAINTENANCE MANUALS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
   02 Instruct Owner's personnel in operation and maintenance of equipment and systems.
   03 Submit two (2) copies of complete manual in final form.

1.2 SUBMITTALS

A. Initial Submittal: Submit to A/E consultant, as applicable, one (1) review / draft copy of each Operating and Maintenance Manual.
   01 Submit directly to the reviewing consultant (architectural, MEP, Structural, Civil, Food Service, etc.); with a copy of the transmittal delivered to the Architect.
   02 The A/E consultant shall return review comments or approval of each O&M manual submission within twenty-one (21) days.

B. If a manual is deemed to be incomplete or contain errors, Contractor shall retrieve the review / draft copy and make all necessary corrections. Once complete, resubmit the complete, correct manual for A/E review.

C. Repeat the above process as necessary to obtain final A/E approval of each O&M manual.

D. Final Submittal: When O&M manuals have been reviewed and accepted for final printing and distribution, submit one (1) complete sets of O&M manuals to Architect; and two (2) flash drives containing PDF files of each O&M manual.
   01 Architect shall deliver final O&M manuals to the Owner.

E. Final copies of O&M manuals shall contain as a minimum:
   01 Table of Contents for each element.
   02 Contractor information for each Contractor / sub-contractor.
   03 All submittals, Coordination Drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
   04 All parts and maintenance manuals for items of equipment.
   05 Warranties (without starting dates)

06 Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
07 Operating and maintenance procedures.
08 Form of Owner's Training Program Syllabus (including times and dates).
09 Control operations/equipment wiring diagrams.
10 Schedule of filters for each item of equipment.
11 Schedule of belts for each item of equipment.
12 Other required operating and maintenance information that are complete.

1.3 QUALITY ASSURANCE

A. It is the Contractor's / sub-contractor's responsibility to compile, review and verify that Operations and Maintenance Manuals are 100% complete and correct in accordance with the specified requirements prior to submission to the Architect / Engineer for review.
01 Failure to comply with required verification may result in return of O&M manuals without a thorough A/E review.

B. Once submitted to the Architect / Engineer for review, the A/E shall review and return any comments and revisions for correction to be incorporated into the final manuals.

C. Schedule for Submission and Delivery:
01 Submit O&M Manuals for review far enough in advance to assure completion of review(s), correction(s), publication of the final O&M manuals, and delivery to the Owner PRIOR to any Owner demonstrations / training involving equipment / systems included in the manual(s).
02 No Owner demonstrations / training shall occur without final, approved O&M manuals have been delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

A. Commercial quality black three-ring binders with clear overlay plastic covers on front and spine.

B. Binders shall be a minimum ring size: 1", and a maximum ring size: 3".

C. When multiple binders are used, correlate the data into related groupings.

D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

2.2 CONTENT

A. Each O&M manual shall include as a minimum the following material and information:
01 Table of Contents for each element, including corresponding specification number.
02 Contractor information for each Contractor / sub-contractor.

03 All submittals, Coordination Drawings and product data, reviewed by the Architect/Engineer; including the Architect/Engineer's stamp of acceptance / review comment sheets. When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.
04 All parts and maintenance manuals for items of equipment.
05 Warranties (without starting dates)
06 Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
07 Operating and maintenance procedures.
08 Control operations / equipment wiring diagrams.
09 Schedule of filters for each item of equipment.
10 Schedule of belts for each item of equipment.
11 Material Safety Data (MSD) sheets
12 Other required operating and maintenance information that are complete.

B. All material will be bound in the 3-ring binder unless otherwise agreed to by the Architect.
01 Sheets that are 8-12 x 14 or 11 x 17 shall be folded to an 8-1/2 x 11 format.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals:
01 Prepare data in form of an instructional manual for use by Owner's personnel.
02 Format:
a. Size: 8-1/2" x 11".
b. Text: Manufacturer's printed data or neatly typewritten.
03 Drawings:
a. Provide reinforced punched binder tab and bind in text.
b. Fold larger Drawings to size of text pages.
04 Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
05 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.
06 Binder as specified.

B. Content of Manual:
01 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:
i. Subcontractor or installer.
ii. Maintenance contractor as appropriate.
iii. Identify area of responsibility of each.

iv. 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.

02 Product Data:

a. Include those sheets pertinent to the specific product.

b. Annotate each sheet to:

i. Identify specific product or part installed.

ii. Identify data applicable to installation.

iii. Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.

03 Drawings:

a. Supplement product data with Drawings as necessary to illustrate:

i. Relations of component parts of equipment and systems.

ii. 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.

04 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.

05 Copy of each warranty, bond and service contract issued.

a. Provide information sheet for Owner's personnel, giving:

i. Proper procedures in event of failure.

ii. Instances that might affect validity of warranties or bonds.

06 Shop Drawings, Coordination Drawings and product data as specified.

C. Sections for Equipment and Systems:

01 Content for each unit of equipment and system as appropriate:

a. Description of unit and component parts.

i. Function, normal operating characteristics, and limiting conditions.

ii. Performance curves, engineering data and tests.

iii. Complete nomenclature and commercial number of replaceable parts.

b. Operating procedures:

i. Start up, break-in, routine and normal operating instructions.

ii. Regulation, control, stopping, shut down and emergency instructions.

iii. Summer and winter operating instructions.

iv. Special operating instructions.

c. Maintenance procedures:

i. Routine operations

ii. Guide to trouble-shooting.

iii. Disassembly, repair and reassembly.

iv. Alignment, adjusting and checking.

v. 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.
    i. Predicted life of part subject to wear.
    ii. Items recommended to be stocked as spare parts.
h. As installed control diagrams by controls manufacturer.
i. Complete equipment internal wiring diagrams.
j. Schedule of filters for each air handling system.
k. Schedule of belts for each item of equipment.
l. Each Contractor's Coordination Drawings.
m. As installed color-coded piping diagrams.
n. Charts of valve tag number, with location and function of each valve.
o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
p. Other data as required under pertinent Sections of the Specifications.

02 Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
03 Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
04 Provide complete information for products specified in Division 22.
05 Provide certificates of compliance as specified in each related Section.
06 Provide start up reports as specified in each related section.
07 Provide signed receipts for spare parts and material.
08 Provide training report and certificates.
09 Provide backflow preventer certified test reports.
10 Provide gas piping pressure test reports.

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
01 Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.

02 Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Work Included:
01 TISD only requests (1) set of hard copy as-built drawings, specifications, and warranty/guarantee documents or similar which have an original signature on the. All remaining documents shall provide in Personal Document Format (PDF) and are to be uploaded into Project Mates including providing (2) separate duplicate thumb drives containing all documents including those provided in hard copy. As-Built drawings shall also be provided in DWG format with the same naming format.
02 The pdf files shall be cataloged in a logical format following CSI whenever possible with a index included. DO NOT simply copy all the files over. File naming shall be logical and consistent between groupings.
03 Drawings and Specifications only shall be provided at all contractual phase completion in the same way, 1 set of hard copy full size, 1 set of hard copy half size and 1 pdf of all documents. All phase drawings shall be uploaded into Project Mates as part of completion of that phase and the electronic thumb drives provided concurrently. During Phase completion only one thumb drive is required.
04 The contractor shall provide the following drawings full size laminated showing valves, disconnects, pull boxes, cleanouts, damper locations, duct detectors, smoke detectors, FCP and all related maintenance and control elements. Submit a paper copy and pdf prior to lamination for acceptance by the Owner:
a. The Mechanical plan of the whole building (2) copies
b. The Electrical plan of the whole building (2) copies
c. The Plumbing drawing of the whole building (2) copies
d. Fire Detection plan of the whole building (2) copies
e. Network/Data/Security/Camara plan of the whole building (2) copies

f. An enlarged plan at ¾”=1’ for the Fire Riser Room, Each Mechanical Room, Each Electrical Room, and the Chiller yard or similar outdoor equipment areas if separate

1.2 DISTRICT REQUIREMENTS

A. Record drawings shall include but not be limited to correct As- Built or As-Constructed documents showing any deviation from the design, actual locations for valves, dampers, detectors, alarms, wall devices, registers, cameras, WAPS, underground piping, underground wiring for site and building interior, overhead duct runs, piping wiring, junction boxes, pull boxes, cut-off valves, switches, resets of any type, and any built element which is different from the design including doors, windows, openings, column wraps, columns, millwork, equipment, etc.

B. Record documents include specifications for any material, equipment or conveyance system.

C. Record documents include SDS sheets for everything which is in the facility whether built, installed or applied. ALL items brought onsite and incorporated within the project must include SDS sheets.

END OF SECTION

SECTION 02 32 00

GEOTECHNICAL INVESTIGATION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. The Geotechnical Investigation Report is not a part of the Contract Documents but is included for Contractor's reference and use in determining specific scopes of work required for the complete project.

C. The Geotechnical Investigation Report specific to this project follows this Section and is identified as:

01	Entitled:	Geotechnical Report Tomball ISD West Agricultural Science Facility
02	Prepared by:	Terracon
03	Project No.:	92255211
04	Dated:	June 18, 2025
05	Total Pages:	44

1.2 APPLICABILITY

A. The Geotechnical Investigation Report is provided for proposer's general information only. Architect and Owner shall not be held responsible for accuracy of data contained in the Geotechnical Report.

01 Questions or request for additional information regarding the Geotechnical Investigation Report shall be made in writing directly to the Geotechnical Lab and copied to the Architect.

B. Prior to submission of proposals, Proposers shall visit and acquaint themselves with existing conditions and make any additional investigations they deem necessary to properly propose work and satisfy themselves as to existing subsurface conditions.

01 Such investigations shall be performed only under time schedules and arrangements approved in advance by the Owner.

02 Upon making on-site observations, the Proposer shall inform the Architect of any discrepancies with the Geotechnical Investigation Report and / or any concerns the Proposer has relative to existing site conditions.

C. No additional cost will be made available to the successful proposer for work arising from his failure to examine site or subsoil conditions prior to proposing. Any soil remediation will be the responsibility of the Contractor at no additional cost to the owner

D. A copy of the Geotechnical Investigation Report is attached to this Section.

SEE ATTACHED REPORT

END OF SECTION

Tomball ISD West Agricultural Science Facility

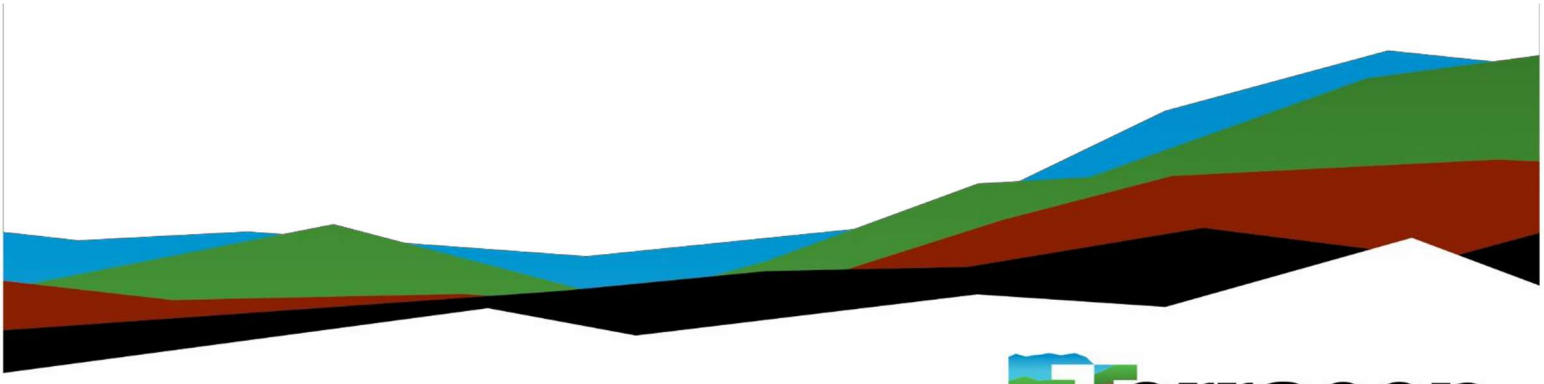
Geotechnical Engineering Report

Tomball, Texas

June 18, 2025 | Terracon Project No. 92255211

Prepared for:

Tomball Independent School District
1110 Baker Drive, Room 102
Tomball, Texas 77375



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June 18, 2025

Tomball Independent School District
1110 Baker Drive, Room 102
Tomball, Texas 77375

Attn: Mr. Zachery Boles – Chief Financial Officer P:
(281) 357-3100
E: zacheryboles@tomballisd.net

Re: Geotechnical Engineering Report
Tomball ISD West Agricultural Science Facility
Cypress Heights Drive and Berry Point Drive
Tomball, Texas
Terracon Project No. 92255211

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.

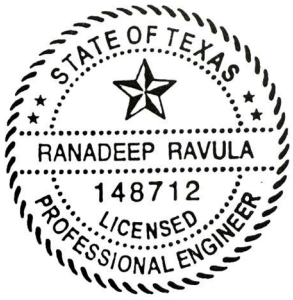
We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.
(Texas Firm Registration No.: F-3272)

Jonathan N. Han, E.I.T.
Senior Staff Engineer

Ranadeep Ravula, P.E.
Group Manager



Kierstyn M. Burrell, P.E.
Geotechnical Services Manager

Table of Contents

Introduction **1**
Site Conditions **1**
Project Description **2**
Geotechnical Characterization **2**
Geology 2
Subsurface Profile 3
Groundwater Conditions 4
Geotechnical Overview **4**
Earthwork **5**
Site Preparation 5
Fill Material Types 6
Fill Compaction Requirements 7
Utility Trench Backfill 7
Grading and Drainage 7
Wet Weather/Soft Subgrade Considerations 8
Foundation Systems **8**
Design Recommendations – Drilled-and-Underreamed Footings 9
Construction Considerations – Drilled-and-Underreamed Footings 10
Grade Beams – Drilled-and-Underreamed Footings 11
Design Recommendations – Drilled Straight Shafts 11
Construction Considerations – Drilled Straight Shafts 13
Foundation Construction Monitoring 15
Floor Slab **15**
Pavements **15**
General Comments **20**

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 proposed agricultural science facility on a site located at the northeast corner of the intersection of Cypress Heights Drive and Berry Point Drive in Tomball, Texas. This project was authorized by Mr. Jim Ross, Director of Tomball Independent School District (TISD) through signature of the AIA® Document B221™ - 2018 between Tomball Independent School District (TISD) and Terracon dated May 17, 2025. This project was performed in general accordance with Terracon Document No. P9225211, dated May 1, 2025.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Earthwork recommendations including site/subgrade preparation;
- Foundation design parameters and construction recommendations; and
- Pavement design guidelines.

The geotechnical engineering Scope of Services for this project included the advancement of six test borings, laboratory testing, engineering analysis, and preparation of this report.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration and Laboratory Results** section.

Site Conditions

The following description of site conditions was derived from our site visit in association with the field exploration.

Item	Description
Project Location	The project is located at the northeast corner of the intersection of Cypress Heights Drive and Berry Point Drive in Tomball, Texas. See **Site Location**.
Existing Improvements	The site was vacant at the time of our field program. Based on available aerial images and our site visit, earthwork activities are ongoing within the project site. Based on previous aerial photographs, a pond with an unknown depth was previously located within the southeast portion of the site in an area outside of the proposed improvements.

Item	Description
Current Ground Cover	Exposed subgrade.
Existing Topography	Relatively Level.

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	▪ A single-story agricultural science building with a footprint area of approximately 35,500 square feet (sf.). ▪ Associated surface pavements and driveways.
Building Construction	Either steel-frame or concrete masonry unit (CMU) construction.
Finished floor Elevation	Within approximately one to two feet above existing grade.
Maximum Loads	▪ **Columns:** 75 to 100 kips ▪ **Floor Slab Pressure:** 125 pounds per square foot (psf)
Planned Foundation System	Either drilled-and-underreamed footings or drilled straight shafts.
Pavements	We assume both rigid (concrete) and flexible (asphalt) pavement sections are being considered. 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.

Geotechnical Characterization

Geology

Based on the geologic maps published by the Bureau of Economic Geology, the site for the proposed project is located on the upper Lissie formation, sometimes denoted the

Montgomery formation. The upper Lissie formation is heterogeneous, containing interbedded layers of clay, sand and silt. This formation was deposited in mid -Pleistocene time in shallow coastal river channels and flood plains.

The clay present in the formation has been preconsolidated by a process of desiccation. Numerous wetting and drying cycles have produced a network of randomly oriented and closely-spaced joints, which are sometimes slickensided, that is, have a shiny appearance when exposed. The joint pattern strongly influences the engineering behavior of the soil.

The sand layers vary in compactness from loose to very dense, and in thickness from a fraction of an inch to many feet due to an irregular depositional environment. Sands are generally subrounded to subangular and vary from coarse to very fine, are poorly graded, and often contain significant amounts of silt-sized particles in the sand matrix.

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 the se 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.

Subsurface Profile

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 o f 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 Silt and Sandy Lean Clay**	dark gray and tan, with sand and clay pockets
2	**Lean Clay and Sandy Lean Clay**	dark gray, light gray, and tan, stiff to very stiff, with ferrous stains and sand pockets
3	**Silty Sand**	light gray, medium dense, with clay pockets

The fill soils observed at this site were compacted to a least 95 percent of the maximum dry density as determined by the Standard Effort (ASTM D 698) and in-situ density tests were performed by Terracon (Terracon Project No. 92245275) at this site. It is our opinion that the degree of compaction of fill soils meet the project compaction requirements at the locations tested. If deeper fill soils are observed at the time of construction in the proposed building area, Terracon should be contacted to provide further recommendations.

Groundwater Conditions

Borings B-1 through B-6 were advanced using dry drilling techniques to their termination depths (about 5 to 25 feet) in an effort to evaluate groundwater conditions at the time of our field program. Groundwater was not observed at borings B-1 through B-6 during or upon completion of drilling.

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 building may be present within the depths explored. 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 -1 through B-6 and extended to depths that ranged from about 2 to 10 feet. Fill soils may be present at varying depths and at other locations not explored during our field program. The fill soils observed at this site were compacted to a least 95 percent of the maximum dry density as determined by the Standard Effort (ASTM D 698) and in-situ density tests were performed by Terracon (Terracon Project No. 92245275) at this site. It is our opinion that the degree of compaction of fill soils meet the project compaction requirements at the locations tested. If deeper fill soils are observed at the time of construction in the proposed building area, Terracon should be contacted to provide further recommendations.

- The surficial soils observed in portions of the site exhibited 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 drilled-and-underreamed footings or drilled straight shafts may be utilized to support the proposed building planned at this site.
- A minimum 12-inch thick select fill pad should be placed under the proposed building to provide uniform support to the floor slab.
- Flexible pavement sections vary from 2.0 to 2.5 inches of asphaltic concrete over 8.0 to 10.0 inches of base material with chemically treated subgrade.
- 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. 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.

Once final subgrade elevations have been achieved, the exposed subgrade should be carefully proofrolled with a 20-ton pneumatic roller or equivalent equipment, such as a fully loaded dump truck, to detect weak zones in the subgrade. Special care should be exercised when proofrolling areas containing fill soils in an attempt to observe soft/weak zones within the fill soils. Weak areas detected during proofrolling, as well as zones of fill containing organic matter and/or debris, should be removed and replaced with soils

exhibiting similar classification, moisture content, and density as the adjacent in-situ soils. Proofrolling should be performed under the direct observation of the geotechnical engineer or his/her representative.

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 D 698) 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 pad under the floor slab and for all grade adjustments within the building area.
On-site Soils[1]	Varies	The on-site, including the documented fill soils, soils appear suitable for use as fill within the pavement areas, 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. Blended or mixed soils do not occur naturally. 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.
Compaction Requirements	The select fill and on-site soils should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density and 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 structure should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building 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 building during and after construction. Water permitted to pond next to the building can result in distress in the building. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. Building slab and foundation performances described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

Exposed ground should be sloped away from the building for at least 10 feet beyond the perimeter of the building. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades

around the building should also be periodically inspected and adjusted as necessary, as part of the building's maintenance program.

Planters located within 10 feet of the proposed building 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 building. Collect roof runoff in drains or gutters. Discharge roof drains and downspouts onto pavements and/or flatworks which slope away from the proposed building or extend down spouts a minimum of 10 feet away from building.

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 low plasticities of the surficial soils observed at portions of 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 drilled-and-underreamed footings or drilled straight

shafts may be utilized to support the proposed building planned at this site, provided the subgrade is properly prepared as described in this report. Recommendations for these type of foundation systems are provided in the following sections, along with other geotechnical considerations for this project.

Design Recommendations – Drilled-and-Underreamed Footings

Item	Description
Minimum Embedment Depth [1]	12 feet below existing grade (grade at the time of our field program)
Allowable Bearing Pressures [2]	Net dead plus sustained live load – 3,600 psf Net total load – 5,400 psf
Maximum Underream-to-Shaft Diameter Ratio	3:1
Minimum Underream-to-Shaft Diameter Ratio [3]	2:1
Estimated Uplift Pressure Due to Post-Construction Heave of the Clay Soils [4]	1,000 psf
Minimum Percentage of Steel [5]	0.5 percent
Approximate Post-Construction Settlement [6]	One inch or less
Estimated Differential Settlement [7]	Approximately ½ of post-construction settlement
Allowable Passive Pressure [8]	1,000 psf
Uplift Resistance [9]	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

1. The footings should extend through the fill soils and bear within the native undisturbed clay soils.
2. Whichever condition yields a larger bearing area.
3. This minimum underream-to-shaft diameter ratio should result in a large enough diameter of the underream to overcome uplift forces on the footing without casing local soil failure to the overlying soils.
4. The magnitude of uplift is difficult to predict and will vary with in-situ moisture contents. This uplift pressure can be approximated over the entire perimeter of the shaft above the top of the underream.
5. The footings should contain sufficient vertical reinforcing steel throughout the entire shaft length to resist uplift (tensile) forces due to post-construction heave of the clay soils. The amount of reinforcing steel required can be computed by assuming that the dead load of the structure surcharges the footing, that the above estimated tensile force acts vertically on the shaft, and that the underream acts as a rigid anchor.

Item	Description
	6. This estimated post-construction settlement of the drilled-and-underreamed footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are being 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. 7. The differential settlement will result from variances in subsurface conditions, loading conditions and construction procedures, such a cleanliness of the bearing area or flowing water in the shaft. 8. 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 and the presence of fill soils, the lateral resistance of the upper 4 feet of the soils at the surface for exterior footings should be neglected unless area paving is provided up to the edge of the building. 9. 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 12 feet below existing grade will be necessary for installation of drilled-and-underreamed footings for the proposed building 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 sand pockets, ferrous stains, 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 soi ls, 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 D 698) maximum dry density at a moisture content within 2 percent of optimum moisture content.

Design Recommendations – Drilled Straight Shafts

Allowable skin friction and end bearing values for drilled straight shaft footings are presented in the following table. These design parameters were computed based on a generalized soil profile and engineering properties of the subsurface soils observed within the depths explored at this site.

Design Parameters for Drilled Straight Shaft Footings		
Below Existing Grade (feet)[1]	**Allowable Unit Skin Friction Resistance (psf)[2] (Factor of Safety = 2)**	**Allowable End Bearing Pressure (psf)[3] (Factor of Safety = 3)**
0 to 4	Disregard	
4 to 10	275	Disregard
10 to 25	480	5,200
1. Grade at the time of our field program.		

Design Parameters for Drilled Straight Shaft Footings		
Below Existing Grade (feet)[1]	**Allowable Unit Skin Friction Resistance (psf)[2] (Factor of Safety = 2)**	**Allowable End Bearing Pressure (psf)[3] (Factor of Safety = 3)**

2. The allowable side friction is based on a rectangular pressure distribution.
3. The net allowable 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 beneat h the shaft tip to use the recommended allowable end bearing pressure.

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 di ameters, 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 ap plied. 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 ab out 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. Foundations should bear at a minimum depth of 10 feet below final grade to help offset the uplift force caused by post-construction heave of expansive soils in the active zone.

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 letter report.

Based on the subsurface conditions observed, the installation of drilled straight shafts may require the use of the Slurry Displacement Method and/or temporary steel casing due to the presence of sandier/siltier zones. If drilled shaft installation is atte mpted 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 sect ion.

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.

Foundation Construction Monitoring

The performance of the foundation system for the proposed building 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 foundations should be observed to evaluate the condition of the subgrade. We would be pleased to develop a plan for compaction and foundation installat ion observation to be incorporated in the overall quality control program.

Floor Slab

Planned finished grades for the proposed building were not available at the time of this report. We anticipate that the finished floor elevation of the proposed building is planned to be within about one to two feet above the 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.

The near surface soils observed within the area of the proposed building generally exhibited 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, we recommend that a minimum 12 inches of properly placed and compacted select fill material be constructed immediately beneath the floor slab. The building pad should extend a minimum of 3 feet beyond the edge of the proposed building area. The final exterior grade adjacent to the structures should be sloped to promote effective drainage away from the building.

Select fill should be utilized for all grade adjustments within the proposed building area. 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, both flexible pavement systems (consisting of asphaltic concrete and base material) and rigid pavement systems may be considered for this project. Detailed traffic loads and frequencies were not available. However, w e anticipate that traffic will consist primarily of passenger vehicles in the parking areas and

passenger vehicles combined with garbage trucks and large multi-axle delivery trucks from time-to-time in driveway areas.

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)

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 be chemically treated with lime-flyash. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. These 6 inch es 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 (su ch as CBR's, resilient modulus tests, etc.) was not performed for this project to evaluate the support characteristics of the subgrade.

Flexible Pavement System		
Component	**Material Thickness, Inches**	
	DI-1	**DI-2**
Asphaltic concrete	2.0	2.5
Base material	8.0	10.0
Treated subgrade	6.0	6.0

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 t o 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 conc rete 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 pot ential 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 with in 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.

Hot Mix Asphaltic Concrete Surface Course – The asphaltic concrete surface course should be plant mixed, hot laid Type D (Fine Graded Surface Course) meeting the requirements in TxDOT 2014 Standard Specifications Item 340. Specific criteria for the job specifications should include compaction to within an air void range of 3.8 to 8.5 percent calculated using the maximum theoretical specific gravity of the mix measured by TxDOT Tex -227-F. The asphalt cement content by percent of total mixture weight should b e within ± 0.5 percent asphalt cement from the job mix design.

Base Material – Base material should be composed of crushed limestone or crushed concrete meeting the requirements of TxDOT 2014 Standard Specifications Item 247, Type A or D, Grade 1 or 2. The base material should be compacted to at least 95 percent of the Modified Effort (ASTM D1557) maximum dry density at moisture content within 2 percent of the optimum moisture content.

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 an d 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 rep ort, 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

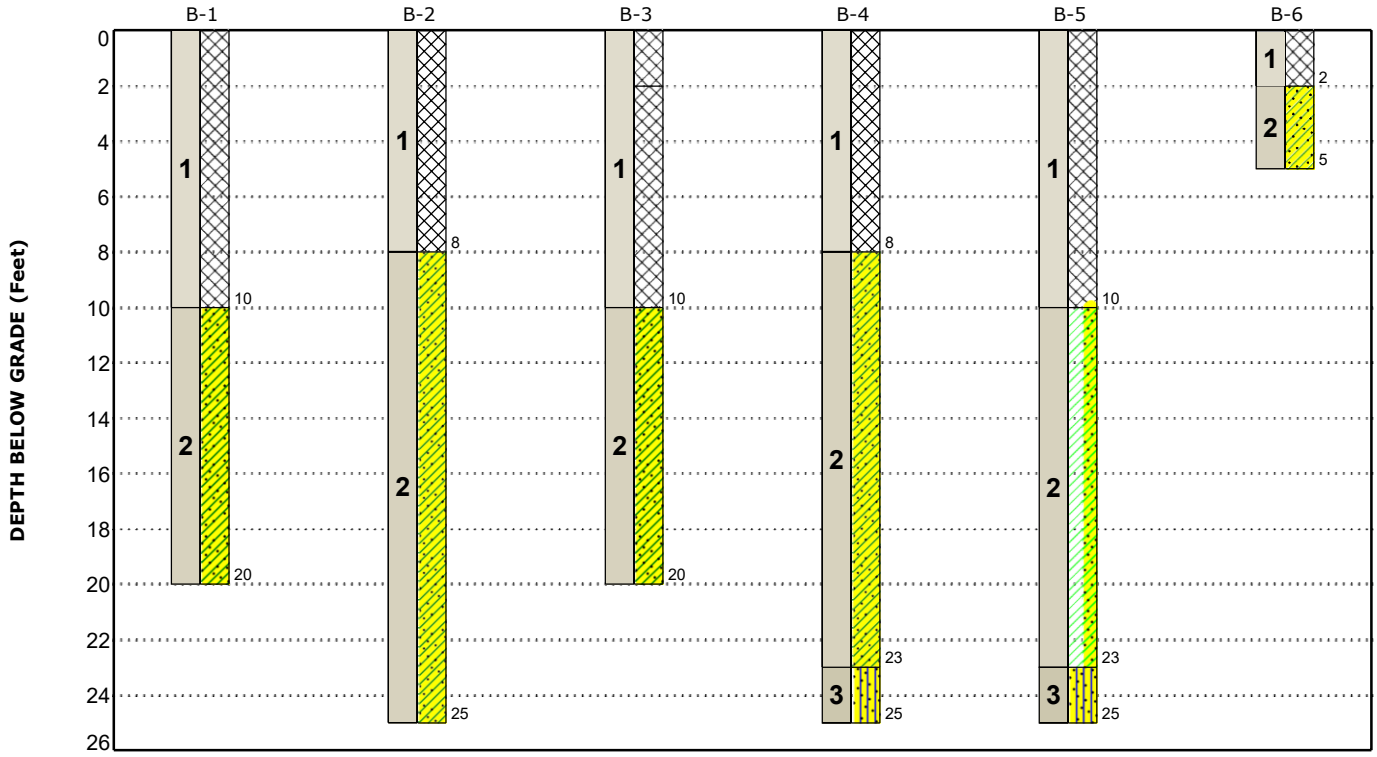
Contents:

GeoModel

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

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 Silt and Sandy Lean Clay**	dark gray and tan, with sand and clay pockets
2	**Lean Clay and Sandy Lean Clay**	dark gray, light gray, and tan, stiff to very stiff, with ferrous stains and sand pockets
3	**Silty Sand**	light gray, medium dense, with clay pockets

Legend

- Fill
- Sandy Lean Clay
- Silty Sand
- Lean Clay with Sand

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
2 (B-1 and B-3)	20	Proposed building area
3 (B-2, B-4, and B-5)[2]	25	
1 (B-6)	5	Proposed pavement area

1. Below existing grade at the time of our field program.
2. Borings were drilled deeper than proposed boring depth due to the fill soils encountered at the site.

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 a standard truck-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. An automatic SPT hammer was used in advancing the split-spoon sampler at the borings. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT N-values and soil properties are based on the lower efficiency cathead and rope method. The higher efficiency of an automatic SPT hammer affects the SPT N-value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method.

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 s. 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 servic e 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 D7263 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D1140 Standard Test Method for Determining the Amount of Materials Finer than No. 200 Sieve in Soils by Washing
- 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

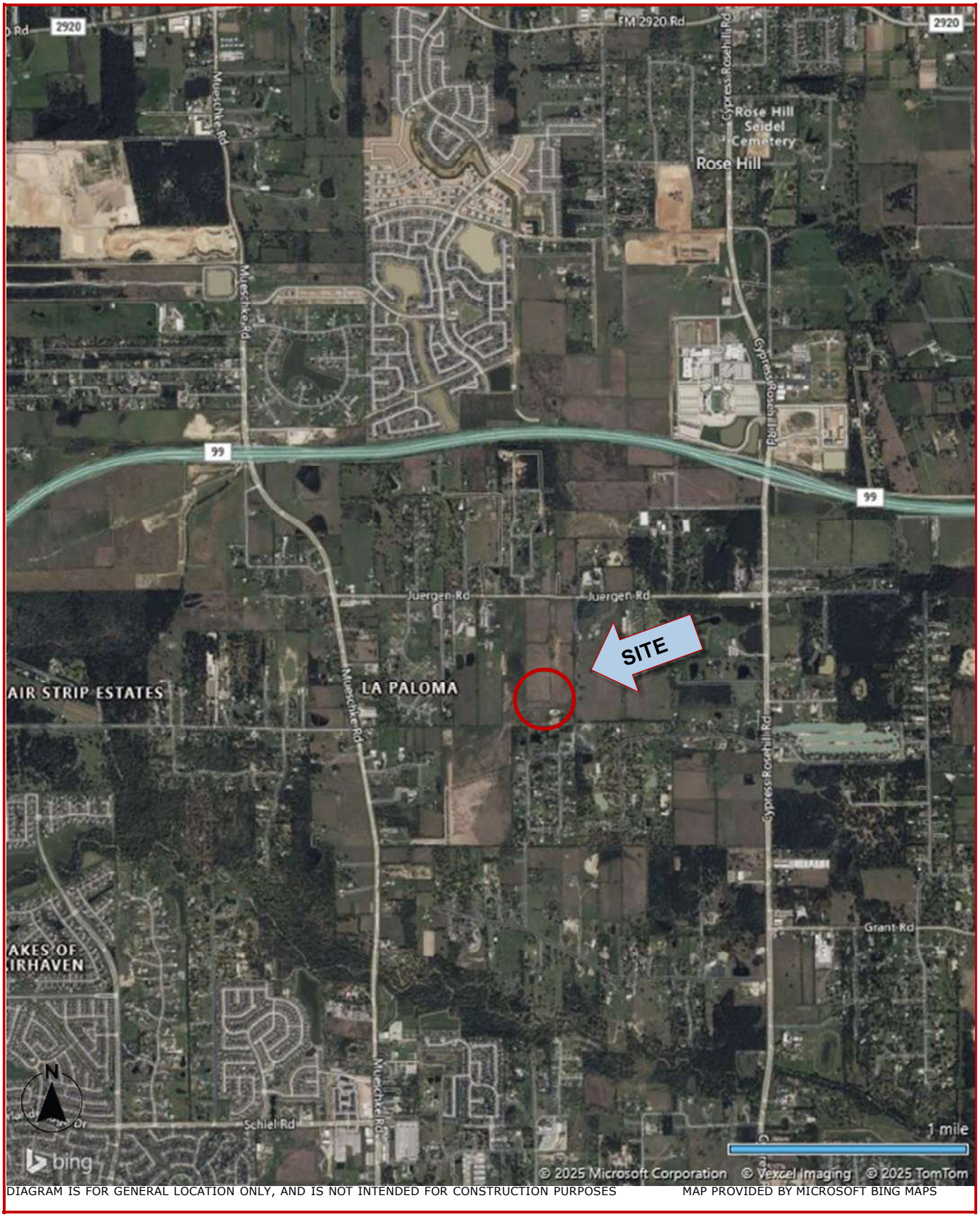


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

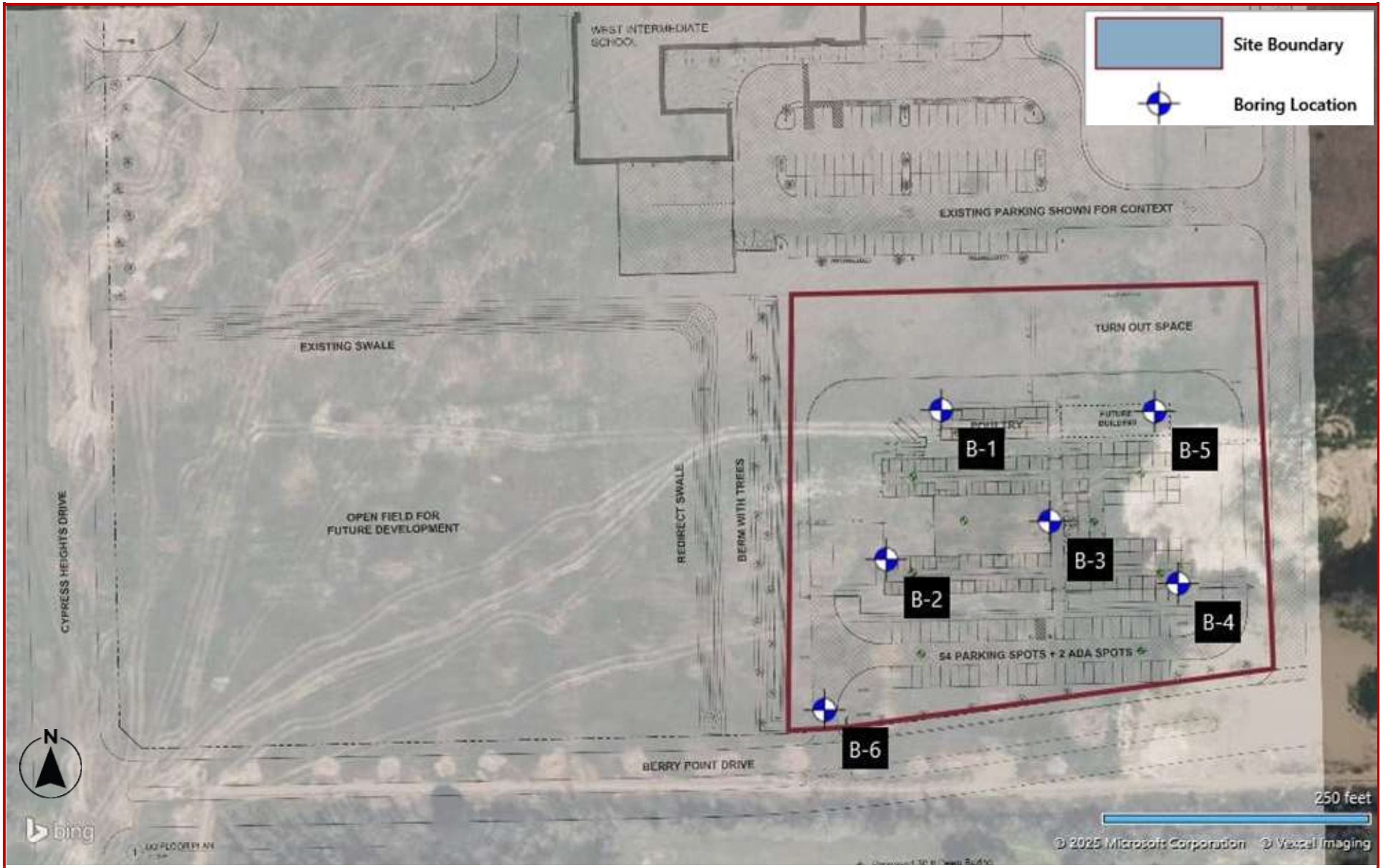


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-6)

Note: All attachments are one page unless noted above.

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 30.0379° Longitude: -95.7133°

Model Layer	Graphic Log	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			4.5 (HP)				12.1		30-15-15	
					2.0 (HP)							
		5			2.0 (HP)				14.6		37-16-21	
					2.5 (HP)	UC	2.16	14.6	15.9	118		
					1.25 (HP)							
2		10			4.5 (HP)	UC	2.42	5.5	11.1	127		59
		15			4.0 (HP)							
					3.5 (HP)							
		20										

FILL - SANDY LEAN CLAY (CL), dark gray and tan, with sand pockets

10.0

SANDY LEAN CLAY (CL), dark gray, very stiff, with sand pockets
- with scattered roots 10 to 13 feet

- light gray below 13 feet

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
Truck

Driller
Herman Drilling

Notes

Advancement Method
Dry augered to 20 feet.

Logged by
H. Zamudio

Boring Started
05-23-2025

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Completed
05-23-2025

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.0375° Longitude: -95.7135° 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 and tan, with sand pockets				4.5 (HP)							
						4.5 (HP)				11.8		22-14-8	
			5			2.0 (HP)	UC	1.43	13.3	14.4	120		55
						2.0 (HP)				11.8		28-15-13	
		8.0											
2		**SANDY LEAN CLAY (CL)**, light gray and tan, stiff to very stiff, with sand pockets				1.5 (HP)							
			10			4.5 (HP)							
						4.5 (HP)							
			15										
						4.5 (HP)	UC	3.97	6.5	13.3	124		
			20										
						3.5 (HP)							
		25.0	25										
		Boring Terminated at 25 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
Truck

Driller
Herman Drilling

Notes

Advancement Method
Dry augered to 25 feet.

Logged by
H. Zamudio

Boring Started
05-23-2025

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Completed
05-23-2025

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-3

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.0376° Longitude: -95.7130° 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
		FILL - SANDY SILT (ML), dark gray, with sand and clay pockets				4.5 (HP)				3.3		16-14-2	
		2.0											
		FILL - SANDY LEAN CLAY (CL), dark gray and tan, with sand pockets				2.0 (HP)							
1			5			2.0 (HP)				15.1		32-15-17	
						2.5 (HP)							
						1.25 (HP)	UC	1.04	4.4	15.4	112		
		10.0	10										
		SANDY LEAN CLAY (CL), light gray and tan, stiff to very stiff, with sand pockets				4.5 (HP)							
2						4.0 (HP)	UC	1.11	6.5	14.3	121		
			15										
						3.5 (HP)							
		20.0	20										
		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
Truck

Driller
Herman Drilling

Notes

Advancement Method
Dry augered to 20 feet.

Logged by
H. Zamudio

Boring Started
05-23-2025

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Completed
05-23-2025

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 30.0375° Longitude: -95.7126°

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
1			**FILL - SANDY LEAN CLAY (CL)**, dark gray and tan, with sand pockets				4.5 (HP)							
							2.0 (HP)				13.8		25-15-10	
				5			2.0 (HP)	UC	1.04	8.2	13.4	119		
							3.75 (HP)				12.7		22-14-8	
		8.0												
2			**SANDY LEAN CLAY (CL)**, gray and tan, stiff to very stiff, with sand pockets				2.0 (HP)							
				10			2.5 (HP)	UC	2.24	8	13.4	123		
							4.5 (HP)							
				15										
							4.5 (HP)							
				20										
3		23.0	**SILTY SAND (SM)**, light gray, medium dense, with clay pockets				6-9-13 N=22							
		25.0		25										
			Boring Terminated at 25 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
Truck

Hammer Type
Automatic

Driller
Herman Drilling

Notes

Advancement Method
Dry augered to 25 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio

Boring Started
05-23-2025

Boring Completed
05-23-2025

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 30.0379° Longitude: -95.7127°

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
1			**FILL - SANDY LEAN CLAY (CL)**, dark gray and tan, with sand pockets				4.5 (HP)				7.7		26-15-11	
							3.0 (HP)							
				5			2.5 (HP)				12.9		30-16-14	
							2.0 (HP)							
							1.5 (HP)	UC	1.27	7.8	17.3	111		
		10.0		10										
2			**LEAN CLAY WITH SAND (CL)**, dark gray, stiff to very stiff, with ferrous stains and sand pockets				1.0 (HP)							
			- light gray 13 to 23 feet				1.75 (HP)							
				15										
							4.5 (HP)	UC	2.15	7.8	16.4	120		82
				20										
3		23.0	**SILTY SAND (SM)**, light gray, medium dense, with clay pockets				4-9-10 N=19							
		25.0		25										
			Boring Terminated at 25 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
Truck

Hammer Type
Automatic

Driller
Herman Drilling

Notes

Advancement Method
Dry augered to 25 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio

Boring Started
05-23-2025

Boring Completed
05-23-2025

Tomball ISD West Agriculture Science Facility
Cypress Heights Drive and Berry Point Drive | Cypress, Texas
Terracon Project No. 92255211

11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-6

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.0372° Longitude: -95.7137° 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 and tan, with ferrous stains and sand pockets				4.5 (HP)				8.5		22-13-9	
		2.0											
2		**SANDY LEAN CLAY (CL)**, light gray and tan, very stiff, with sand pockets				2.5 (HP)							
						2.25 (HP)							
		5.0	5										
		Boring Terminated at 5 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
Truck

Driller
Herman Drilling

Notes

Advancement Method
Dry augered to 5 feet.

Logged by
H. Zamudio

Boring Started
05-23-2025

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Completed
05-23-2025

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 Split Spoon	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	4 - 8
Stiff	1.00 to 2.00	8 - 15
Very Stiff	2.00 to 4.00	15 - 30
Hard	> 4.00	> 30

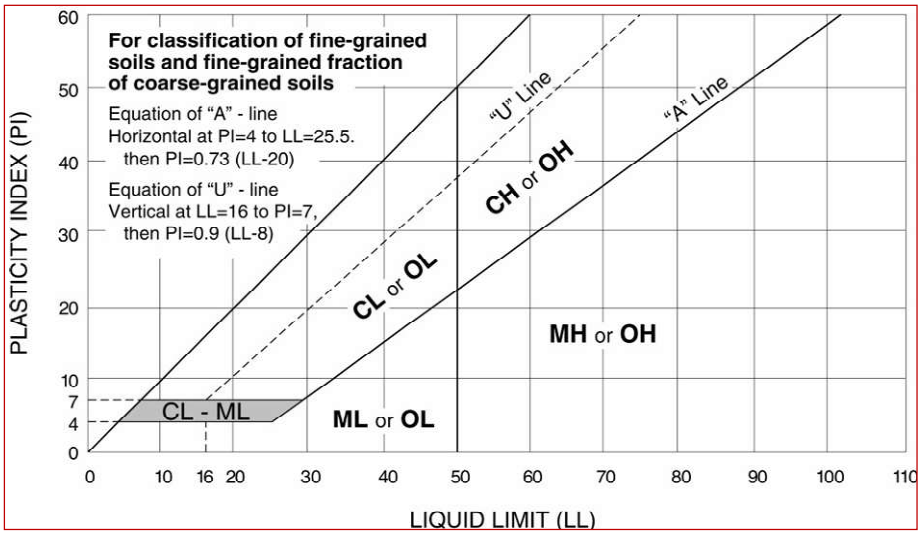
Relevance of Exploration and Laboratory Test Results

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. 200 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 00

DEMOLITION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Demolishing and removing existing pavement, structures, equipment, and materials as shown on the plans.

B. Disposal of demolished materials and equipment.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for Work In this Section is included in total Stipulated Price.

1.3 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt, and debris.

B. Use appropriate controls to limit noise from demolition to acceptable levels.

C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Stop demolition and notify Engineer if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.

E. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Dispose of removed equipment, materials, waste, and debris in a manner conforming to applicable laws and regulations.

PART 2 P R O D U C T S

2.1 EQUIPMENT AND MATERIALS FOR DEMOLITION

A. Fires shall not be permitted.

B. The use of a "drop hammer" shall not be permitted where the potential for damage to underground utilities exists.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Prior to demolition, make an inspection with Engineer to determine the condition of existing structures and features adjacent to items designated for demolition.

B. Engineer will mark or list existing equipment to remain on the property of the Owner.

C. Do not proceed with demolition or removal operations until after the joint inspection and

subsequent authorization by Engineer.

3.2 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe all safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings at all times. Do not obstruct roadways, sidewalks, or passageways adjacent to the work.

C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to Owner's property or adjacent property and facilities.

D. The Contractor shall be responsible for the safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered. Resume demolition only after proper protective measures have been taken.

E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.3 UTILITY SERVICES

A. Follow rules and regulations of authorities or utility companies having jurisdiction over water, natural gas, electricity, or telephone services.

B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

C. Call before you dig (locates) to be coordinated by contractor.

D. Notify owner of demolition schedule to allow owner sufficient time to locate.

3.4 DISPOSAL

A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage.

B. Follow method of disposal as required by regulatory agencies.

3.5 BACKFILL

A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to density of adjacent soil.

B. Do not backfill with material from demolition unless approved by Engineer.

END OF SECTION 02 41 00

SECTION 02 41 13.10

REMOVING EXISTING PAVEMENT AND STRUCTURES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Removing concrete paving, asphaltic concrete pavement, and base courses.
B. Removing concrete curbs, concrete curbs and gutters, sidewalks, and driveways.
C. Removing pipe culverts and sewers.
D. Removing existing inlets and manholes.
E. Removing miscellaneous structures of concrete or masonry.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for removing and disposing of asphaltic surfacing and unreinforced concrete base under asphaltic surfacing, regardless of the thickness encountered, is on a square yard basis measured between lips of gutters.
2. Payment for removing and disposing of concrete base under surfacing with curbs, regardless of the thickness encountered, is on a square yard basis measured from back-to-back of curbs. Payment includes removal of all concrete base, asphaltic surfacing, concrete pavement, esplanade curbs, curb and gutters, and paving headers.
3. Payment for removing and disposing of reinforced concrete pavement, regardless of its thickness, is on a square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.
4. Payment for removing and disposing of monolithic curbs and gutters, and concrete curbs, is on a linear foot basis measured along the face of the curb.
5. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on a square yard basis.
6. Payment for removing and disposing of concrete sidewalks is on a square yard basis.
7. Payment for removing and disposing of concrete driveways is on a square yard basis.
8. Payment for removing and disposing of miscellaneous concrete and masonry is on a cubic yard basis of the structure in place.
9. Payment for removing and disposing of pipe culverts and sewers is on a linear foot basis for each diameter and each material type of pipe removed.
10. Payment for removing and disposing of existing inlets is on a unit price basis for each inlet removed.
11. Payment for removing and disposing of existing manholes is on a unit price basis for each manhole removed.
12. Payment for saw cutting of existing pavement is on a linear foot basis.
13. No payment will be made for work removed with out the Engineer’s approval or for pavements or structures removed for the Contractor's convenience.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.
B. Coordinate removal work with utility companies.

PART 2 P R O D U C T S – Not Used

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Obtain advance approval from Engineer for dimensions and limits of removal work.
B. Identify known utilities below grade. Stake and flag locations.

3.2 PROTECTION

A. Protect the following from damage or displacement:

1. Adjacent public and private property.
2. Trees, plants, and other landscape features designated to remain.
3. Utilities designated to remain.
4. Pavement and utility structures designated to remain.
5. Bench marks, monuments, and existing structures designated to remain.

3.3 REMOVALS

A. Remove pavements and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
B. Minimize amount of earth loaded during removal operations.
C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of two (2) inches.
D. Where street and driveway saw cut locations coincide or fall within three (3) feet of existing construction or expansion joints, break out to existing joint.
E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
F. Where existing end of pipe culvert or end of sewer is to remain, install an 8-inch thick masonry plug in pipe end prior to backfill.

3.4 BACKFILL

A. Backfill of removal areas shall be in accordance with requirements of Division 31.

3.5 DISPOSAL

A. Inlet frames, grates, plates, and manhole frames and covers may remain property of the Owner. Disposal shall be in accordance with requirements of Section 01 74 19 – Construction Waste Management and Disposal.
B. Remove from the site debris resulting from work under this section in accordance with requirements of Section 01 74 19 - Construction Waste Management and Disposal.

END OF SECTION 02 41 13.10

SECTION 03 15 19

BELOW SLAB VAPOR MEMBRANES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all vapor retarder membranes, vapor barrier membranes and related accessories as required forming a complete, 100% sealed membrane below building foundations and slabs.
   02 Coordinate Work with other trades to seal all penetrations through the slab membrane.

C. Related Work:
   01 Section 01 45 23 – Testing and Inspection Services
   02 Section 03 30 00 – Cast-In-Place Concrete

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication, and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections, and details.
   03 Show details of field fabrications, connections, and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.
   03 Installation shall be in strict accordance with ASTM E1643.
   04 Provide details to be used to seal the perimeter of the vapor barriers to the foundation per ASTM E1642-11.
   05 Provide details to be used to seal other trade work that penetrates the slab membrane.
   06 Provide details to be used to seal penetrations made by temporary form stakes.

E. Tests and Certifications:

01 Summary of test results per paragraph 9.3 of ASTM E1745.
02 All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.
03 Upon completion of slab membrane installation and foundation preparation immediately prior to placement of concrete, manufacturer's rep shall inspect membrane installation and provide certification that installation is complete, and in accordance with specified requirements.

F. Actual Samples of Proposed Materials:
01 Vapor retarder membrane, 8" x 10" minimum size.
02 Vapor barrier membrane, 8" x 10" minimum size.
03 Membrane perimeter grade beam sealing device(s).
04 Joint / seam tape, 12" minimum length.
05 Pre-formed penetration boot (each type).

1.3 REFERENCES

A. American Concrete Institute (ACI):
01 Detailing Manual.
02 ACI 302.2R-06 – Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

B. U.S. Federal Specifications:
01 Fed. Spec. SS-S-158.
02 Fed. Spec. SS-S-164.

C. American Society for Testing and Materials (ASTM):
01 ASTM D882 – Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
02 ASTM D1709 – Standard Test Methods for Impact Resistance of Plastic Film by the Free Falling Dart Method.
03 ASTM E154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
04 ASTM E1643 – Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
05 ASTM E1745 Class A – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.4 SITE CONDITIONS

A. Do not proceed with membrane installation until all subgrade testing is complete and found to be in compliance with specified requirements.

B. Subgrade Conditions:
01 Inspect subgrade conditions as required to confirm adequacy for installation of slab membrane work in accordance with manufacturer's standards and specified requirements.
02 Verify that under-slab work of other trades is complete and does not present any conditions that may prevent the proper installation of slab membrane work in accordance with manufacturer's standards and specified requirements; or create a potential for breaching the membrane after it is installed.
03 Notify Contractor of any discrepancies, deficiencies and / or issues. Do not proceed until fully resolved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS – VAPOR RETARDER MEMBRANES

A. Under Slab Vapor Retarder Membrane: Design is based on products / systems manufactured by Stego Industries.

B. Other acceptable manufacturers: the following manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 Reef Industries.
   02 Sundance, Inc.

2.2 MANUFACTURERS – VAPOR BARRIER MEMBRANES

A. Under Slab Vapor Barrier Membrane: Design is based on products / systems manufactured by Stego Industries.

B. Other acceptable manufacturers: the following manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 Reef Industries.
   02 Sundance, Inc.

2.3 VAPOR RETARDER BELOW-SLAB MEMBRANES

A. Design of Vapor Retarder Membrane is based on Stego Industries 15 mil Stego Wrap Vapor Barrier membrane.
   01 Provide all materials and accessories as specified and recommended by the manufacturer for a complete under slab membrane system.

B. Provide vapor retarder membrane below all building slabs / foundations except areas described below to receive vapor barrier membrane.

C. Under Slab Vapor Retarder Membrane:
   01 Material: manufactured from a blend of the highest quality polyolefin resins.
   02 Vapor Retarder / Slab Membrane shall be a manufacturer's complete system including but not limited to membrane, joint tape, penetration boots, mastic / sealant, and other accessories as supplied by the manufacturer.
   03 High strength, flexible, polyolefin resin based, low-permeance, geo-membrane vapor retarder system.
   04 Meeting or exceeding all requirements of ASTM E1745, Class A.
   05 Thickness: 15 mils minimum; no exceptions.
   06 Water Vapor Permeance rating of less than 0.01 perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1.2 – 7.1.5.
   07 Puncture Resistance: Exceeds 2,300 grams per ASTM D1709 Method B.
   08 Tensile Strength: Exceeds 55 PSI per ASTM D882.

2.4 VAPOR BARRIER BELOW-SLAB MEMBRANES

A. Design of Vapor Barrier Membrane is based on Stego Industries 20 mil Stego Wrap Vapor Barrier membrane.
   01 Provide all materials and accessories as specified and recommended by the manufacturer for a complete under slab membrane system.

B. Provide vapor barrier membrane below all building slabs / foundations scheduled or

shown to receive finish wood flooring systems; to include, but not necessarily limited to:
01 Gymnasiums.
02 Theater Stage / Aprons.

C. Under Slab Vapor Barrier Membrane:
01 Material: manufactured from a blend of the highest quality polyolefin resins.
02 Vapor Retarder / Slab Membrane shall be a manufacturer's complete system including but not limited to membrane, joint tape, penetration boots, mastic / sealant, and other accessories as supplied by the manufacturer.
03 High strength, flexible, polyolefin resin based, low-permeance, geo-membrane vapor retarder system.
04 Meeting or exceeding all requirements of ASTM E1745, Class A.
05 Thickness: 20 mils minimum; no exceptions.
06 Water Vapor Permeance rating of less than 0.01 perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1.2 – 7.1.5.
07 Puncture Resistance: Exceeds 3,500 grams per ASTM D1709 Method B.
08 Tensile Strength: Exceeds 97 PSI minimum per ASTM D882.

2.5 OTHER VAPOR MEMBRANES MATERIALS AND ACCESSORIES

A. Vapor Retarder Membrane Seam Tape and Perimeter Seal:
01 Design is based on Stego Industries "Crete Claw" seam tape with a heavily textured top that forms a mechanical bond to the wet concrete.
02 Width: minimum 6".
03 High density polyethylene tape with pressure sensitive adhesive specifically formulated for use with the polyolefin membrane.
04 Permeance: 0.03 maximum.
05 Thickness: shall be same as membrane or thicker.
06 In addition to application at membrane seams, apply tape on a maximum 10' x 10' grid throughout the membrane surface to assure consistent and complete attachment to the structural concrete foundation.

B. Membrane Penetrations:
01 All penetrations through the vapor barrier membrane shall be completely sealed.
02 Methodology shall be as recommended by the manufacturer.
03 Design is based on Stego Tape and Stego Mastic in accordance with manufacturer's standards and recommendations for the specific application.
04 Other methods (i.e. preformed boots) will be consider based on manufacturer's recommendations, subject to approval by the Architect.

C. System Requirements:
01 The vapor retarder membrane shall be a system specifically designed or suited to be applied to a structural concrete foundation where the slab is elevated above grade.
02 The vapor retarder system must adhere to the underside of the foundation and remain in place after deterioration of the cardboard carton forms used to form the structural slab.
03 Attachment to the structural foundation by any means that penetrate the vapor barrier membrane shall not be accepted.
04 The perimeter grade beams of the structural foundation shall bear on subgrade. The system shall extend to the outside face of the grade beams and be similarly permanently attached.

D. Accepted methods of membrane attachment to underside of structural foundation:

01 Use of a seam tape and / or seam tape grid that is capable of permanently bonding with the concrete at the time it is poured (basis of design).
02 Use of a membrane that has an integral fleece back designed to permanently bond with the concrete at the time it is poured.

PART 3 - EXECUTION

3.1 PREPARATION

A. Foundation Preparation: Verify the following is complete and acceptable prior to installation of under slab membranes:
   01 Foundation formwork.
   02 Underground work of other trades.
   03 All work that will penetrate the vapor membrane.

B. Verify the area to receive under slab membranes is free from other trade work, obstructions and / or foreign objects that may puncture the membrane after installation.
   01 Notify Contractor of any issues and / or concerns and do not proceed until satisfactorily resolved.

C. Drilled Piers / Plinths: Thoroughly clean concrete plinths and prepare for sealing under slab membrane to pier tops / plinths in accordance with membrane manufacturer's installation instructions.

D. Provide a means of sealing form stakes and other temporary penetrations through the under slab membrane.

E. VaporStakes® or other approved permanent stakes, sealed with mastic or seam tape at membrane penetration as recommended by the membrane manufacturer, and approved by the Architect.

F. Temporary form block-out that will allow patching membrane after the stake is removed; leaving room for patching and sealing membrane.

3.2 UNDER SLAB MEMBRANE INSTALLATION

A. Install membrane systems in strict accordance with manufacturer's recommendations and requirements, and in accordance with ASTM E1643.
   01 Installation shall provide a continuous, sealed membrane barrier beneath all building foundation area and below all grade beams through to the top of the exterior face.
   02 If / where membrane is interrupted (i.e. drilled footings, plinths, and similar), membrane shall be sealed to concrete surface per manufacturer's recommendations.
   03 Membrane shall extend through and up outside face of perimeter grade beams to finish grade line.
   04 Membrane shall be integrally and continuously attached to grade beam outside face per manufacturer's recommendations.

B. Install Vapor Retarder membrane system below all building foundations on properly compacted structural fill pad.

C. Lay out membrane in as full sheets as possible, minimizing the amount of joints / seams.

D. Lap joints / seams 6" minimum and seal continuously with membrane manufacturer's

system joint tape covering full laps in accordance with manufacturer's instructions.

01 Clean all debris, dirt and other contaminants from membrane surfaces to receive joint tape.

E. Penetrations by Other Trades:

01 Work by other trades that penetrate membrane from subgrade to above slab shall be sealed 100% to ensure and maintain under slab barrier effectiveness.

02 Provide manufacturer's tape, mastic, preformed boots or accurately cut, site fabricated membrane boots per manufacturer's instructions and recommendations.

03 All penetration sealing assemblies shall above finish slab elevation a minimum of 6" and be sealed with seam tape and / or mastic to penetrating object.

04 Where multiple penetrations occur in close proximity, use mastic to completely fill all voids and potential areas where water vapor could penetrate the assembly in strict accordance with manufacturer's standards recommendations.

F. Temporary Form Penetrations:

01 Where temporary forms are used to separate slab pours create slab recesses and other types of offsets, supporting stakes penetrations through the slab membrane shall be sealed 100%.

02 Acceptable permanent stakes to remain in the slab are acceptable, provided they are sealed with mastic in accordance with manufacturer's installation instructions. Wood stakes are not acceptable permanent stakes.

03 Where temporary stakes are removed from the finished slab, provide an acceptable means by which the hole through the membrane can be patched and sealed with membrane, seam tape and / or mastic.

04 Completely fill stake voids with concrete as soon as practical while slab concrete is still plastic.

G. Take all necessary precautions during concrete placement as required to prevent puncture of the under slab membrane.

01 During concrete placement, continuously monitor / inspect the under slab membrane.

02 Seal any / all membrane punctures before placement of concrete.

3.3 INSTALLATION CERTIFICATION

A. The vapor barrier membrane manufacturer shall provide the services of a qualified representative to provide the following services:

01 Inspect the building foundation / slab prep to determine it is suitable for the membrane installation to commence.

02 Inspect the membrane installation during installation to confirm all requirements, standards and recommendation are being strictly adhered to.

03 Inspect the final foundation prep 24 hours prior to placement of concrete to verify that the vapor membrane system is correct.

04 Be present during concrete placement to observe that all requirements regarding the vapor membrane system are being adhered to.

B. Correct all deficiencies noted by the inspector as required for his approval.

C. Provide a letter from the manufacturer certifying the installation is complete and acceptable to proceed with placement of concrete.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all concrete and concrete accessories required for a complete installation.
   02 Building Foundation: Including drilled piers, grade beams, spread footings foundation walls, and / or slab on grade.
   03 Steel structure supported slabs.
   04 Site paving, curbs flatwork and sidewalks.
   05 Foundations for site lights.
   06 HVAC equipment support structures and housekeeping pads.
   07 Coordinate with all other trades to confirm requirements and scope required for all associated work.

C. Related Work:
   01 Section 01 22 00 – Unit Prices
   02 Section 01 45 23 – Testing and Inspection Services
   03 Section 03 15 19 – Below Slab Vapor Membrane
   01 Section 31 20 00 – Earth Moving
   02 Section 31 32 13.19 – Lime Soil Stabilization
   03 Section 32 13 13 – Concrete Paving and Flatwork

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Proposed mix designs for each different concrete mix proposed to be furnished, including adequate historical documentation of previous use to substantiate performance and strengths.

D. Tests and Certifications:
   01 Before starting any work under this Section, make all required arrangements with the testing agency. The testing laboratory shall test and furnish certified reports on proposed cements, aggregates, mixing water and admixtures.
   02 Submit proposed design mixes for each type of concrete using previously tested and approved materials.
   03 Furnish certified reports of each proposed mix for each type of concrete.

04 Proportion mixes by laboratory trial batch or field experience methods, using materials to be employed in the work for each class of concrete required, and report to the Architect.
05 Refer to Section 01 45 23 – Testing and Inspection Services for on-site procedures and testing requirements.
06 Furnish ready mix delivery tickets.

E. Shop Drawings:
01 Shop Drawings for all reinforcing steel. Show bending diagrams, splicing and laps of rods, shapes, dimension and details of bar reinforcement and accessories.
02 Shop Drawings showing location of all proposed formwork construction and control joints, keying / keyways, water stops, openings, depressions, trenches, sleeves, inserts, and other items affecting reinforcement and placement of concrete.
03 Placement sequence schedule may be combined with Item 02.
04 Unless shown on the Site Plan, submit proposed layout for all expansion joints in paving, flatwork and sidewalks.

F. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
02 Generic details that do not depict actual conditions shall not be acceptable.

G. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

H. Color / Finish Samples for Colored Concrete:
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3" x 3", but must be large enough to convey attributes of the proposed product.

I. Actual Samples of Proposed Materials: Provide two (2) actual samples of the following products proposed to be furnished.
01 Plastic rebar chair supports.
02 Water stops.
03 Stains: full range of manufacturer's available color selections.

1.3 REFERENCES

A. American Concrete Institute:
01 Detailing Manual.
02 ACI 301 – Specifications for Structural Concrete.

B. U.S. Federal Specifications:
01 Fed. Spec. SS-S-158.
02 Fed. Spec. SS-S-164.

C. American Society for Testing and Materials:
   01 ASTM A1064 – Welded Steel Wire Fabric for Concrete Reinforcement.
   02 ASTM A615 – Steel Bars for Concrete Reinforcement.
   03 ASTM A704 – Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
   04 ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   05 ASTM C33-379 – Standard Specifications for Concrete Aggregates.
   06 ASTM C94 – Standard Specifications Ready Mix Concrete.
   07 ASTM C150 – Standard Specifications for Portland Cement.
   08 ASTM C260 – Specifications for Air Entraining Admixtures for Concrete.
   09 ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   10 ASTM C494 – Standard Specifications for Chemical Admixtures for Concrete.
   11 ASTM C979 – Standard Specification for Pigments for Integrally Colored Concrete
   12 ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

D. American Association of State Highway and Transportation Officials (AASHTO):
   01 AASHTO M-213-74 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
   02 AASHTO M-148 – Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

E. Portland Cement Association: Joint Design for Concrete Highway and Street Pavement, Concrete-Typical Pavement Sections and Jointing Details.

1.4 SITE CONDITIONS

A. Environmental Conditions:
   01 Do not place concrete in contact with frozen earth.
   02 Do not commence concrete placement unless temperature is at least 35°F (2°C) and rising, or slabs until the temperature rises above 40°F.
   03 Discontinue concrete placement when air temperatures exceed 95°F.
   04 Do not place concrete during rain unless adequate protection is provided.

B. Subgrade Conditions:
   01 Inspect subgrade conditions as required to confirm adequacy for concrete work to proceed.
   02 Notify Contractor of any discrepancies, deficiencies and / or issues. Do not proceed until fully resolved.

C. Equipment and Manpower:
   01 Verify adequate equipment, in good working condition, is provided for all concrete pours.
   02 Verify adequate manpower is provided for concrete pours.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Joint Sealant:
   01 Pecora
   02 BASF / Sonneborn

03 Tremco
04 W.R. Meadows

B. Acceptable Manufacturers: Reinforcing Chairs:
01 Dayton Aztec Castle Chairs
02 OCM, Inc.
03 No other substitutions.

C. Acceptable Manufacturers: Water-stops (also refer to Structural Drawings):
01 Durajoint – Seal-Tite
02 Henry Company – Synko-Flex
03 Vinylex Corporation – Blue Stop

D. Acceptable Manufacturers: Curing Compound:
01 Nox-Crete-Cure & Seal 100-300 E
02 Shepler's – Shep-Cure 309 Rez All
03 Sonneborn – Kure-N-Seal
04 W.R. Meadows – Vocomp-20

E. Acceptable Manufacturers: Concrete Color Pigment (Stain):
01 Bomanite
02 Davis Colors
03 L.M. Scofield
04 New Riverside Ochre Co., Inc.

2.2 CONCRETE MATERIALS

A. Concrete:
01 General:
a. Ready-mixed concrete, ASTM C94.
b. Comply with ACI 318.
c. Concrete must be approved by Architect through design mix and cylinder test of testing laboratory.
02 Cement: Type 1, ASTM C150, unless approved otherwise by the Architect. Use one brand of cement for entire project.
03 Aggregates:
a. Comply with ASTM C33. Aggregate shall be limestone at paving.
b. Maximum size not larger than one-fifth of the narrowest dimension between forms of the member for which concrete is to be used. Not larger than three-fourths of minimum clear spacing between reinforcing bars.
c. Maximum 1 ½ inches in building slabs.
04 Admixtures:
a. Approval necessary from Architect and testing laboratory.
b. Use of Calcium Chloride, accelerants, or additives shall not be permitted unless there is prior written approval by the Architect and Engineer of Record.
c. Color Pigment: At areas indicated on drawings provide pigment at 5 pounds per 94-pound sack of cement. Follow manufacturers' recommendations.
05 Strengths:
a. 5 sack/3000 psi/28 days: all concrete including grade beams, footings, slabs, pavements, walks.
b. Strength recommendations on Structural Drawings supersede when they are greater than specified here.

06 Water: Drinking quality.
07 Slump:
a. Reinforced foundation walls and footing – 5-1/2 inch max.
b. Slabs, beams, columns and reinforced walls – 6-inch max.
c. Pavement – 5-1/2 inch max.

B. Metal Reinforcing Bars:
01 General: Conform to ACI Publication 315, latest edition.
02 Comply with ASTM A615, Grade 60.
03 #3 bars comply with ASTM A615, Grade 40.

C. Joints:
01 Construction Joint (Building Slab):
02 Standard type permanent galvanized keyed contraction expansion joints, with 5 stakes per 10 feet of joint length.
03 Joint may be left in place when concrete is placed on each side simultaneously. Remove when mold as edge form prior to subsequent concrete placement.
04 Expansion Joint:
a. Fiber Joint Filler: ¾ inch thick, pre-molded asphalt impregnated rigid fiber board. Comply with AASHTO M-213-74 or redwood.
b. Cap sealant: Comply with Fed. Spec. TT-S-00227E "Two Component", 100% Urethane (light grey).
05 Tooled Joint: Scored ¼" wide x ¼" the thickness of the concrete in depth.
06 Saw-Cut Joint: 1/8" wide x ¾" to 1" deep.

D. Waterstops – Flexible:
01 Design based on Henry Company SF302 Synko-Flex Waterstop; or accepted equal.
02 Asphalt based, non-hydrophilic / non-expanding waterstop.
03 Continuous, flexible, moldable strip with protective wrapping.
04 Size: 1" wide x ¾" deep.

E. Rebar Chairs and Spacers:
01 Aztec "Castle Chair".
02 OCM, Inc. – "Plastic Cradle Chair".
03 Heavy-duty plastic-type sized to support all slab steel at proper height.
04 Use type with sand cushion pads where concrete is on grade.

F. Form Ties:
01 Form Ties: Adjustable length and type which will not leave holes larger than 1 inch in diameter in the face of the concrete.
02 Ties shall be such that when forms are removed, no metal will be within 1 inch of the finished concrete surface.
03 The holes must be patched.

G. Curing Compound: Design is based on WR Meadows VOCOMP-20; or equal by an acceptable manufacturer.
01 Water based, dissipating curing compound for freshly placed concrete.
02 Comply with ASTM C309 Type II.
03 Minimum 18% solids.
04 Meets all VOC emission requirements.
05 Initially non-clear for visual verification of adequate coverage.

H. Cardboard Carton Void Forms: Permitted only if specifically indicated on the

Drawings.
01 Wax impregnated, trapezoidal shape.
02 Use only if / where indicated on the Structural Drawings.

2.3 COLORED CONCRETE

A. Design of colored concrete is based on products / systems manufactured by Bomanite.

B. Field Colored Concrete: Equal to Bomanite “Color Hardener” system – Heavy Duty Grade for high wear resistance.
01 A blend of mineral oxide pigments, cement and graded silica aggregates applied to freshly placed concrete as recommended by the manufacturer.
02 Color as selected by Architect from full range of manufacturer’s colors.
03 Provide at all ramps as required by Americans with Disabilities Act and Texas Department of Licensing and Registration “Texas Accessibility Standards”.
04 Provide at all areas designated “Colored Concrete”.

C. Batch Plant Colored Concrete: Equal to Bomanite “Integral Color” color admixture system.
01 Comprised of high-quality pigments and other ingredient designed to enhance the color and pigment dispersion, workability and finishing performance of the concrete.
02 Integral Coloring Admixture: Bomanite Integral Color synthetic oxide pigment meeting requirements of ASTM C979 and C494; in type as recommended by the manufacturer for the specific application.
03 Integral color shall be added to concrete at the batch plant as recommended by the manufacturer.
04 Once mixed, no water shall be added to the design mix to maintain quality and consistency of the color.
05 Color as selected by Architect from full range of manufacturer’s colors.
06 Provide at all areas designated “Colored Concrete”.

D. Sealing and Finishing Coat: Equal to Bomanite “Hydroblock”.

2.4 SLAB MEMBRANES

A. Refer to Section 03 15 19 – Below Slab Vapor Membranes.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
01 Clean all mixing and transportation equipment; remove debris from forms; wet forms thoroughly; remove ice or other coatings from reinforcement which might hinder good bond; remove water from place of deposit; and check reinforcement.

B. Accessories:
01 Install anchor bolts, slots, dove-tail anchor slots, boxes, sleeves and other required devices. Provide all such items not specified to be provided by other trades.

02 Provide temporary supports to maintain accessory location / position during concrete placement and initial finishing. Remove temporary supports as required.

C. Coordination:
01 Unless specifically shown or allowed in other Specification Sections and / or Drawings, no horizontal runs of conduit, piping or other work shall be allowed within the slab.
02 All underground conduit runs (if allowed) shall be trenched / installed within the building pad, a minimum 6" below the slab. Refer to Electrical Drawings and Specifications.
03 Exception to 02: Only conduit runs to floor mounted or recessed receptacles at finish floor may be installed above the slab membrane provided all following conditions are met:
a. 3/4" maximum conduit size allowed provided the conduit is recessed below the slab thickness indicated.
b. Length of conduit run is minimized to turn up at the nearest available building component (partition, furring, etc.) to allow conduit to be concealed above the slab.
c. Such installations are not specifically excluded in other Sections or the Drawings.
04 All penetrations through concrete grade beams and elevated beams shall be sleeved.
05 Coordinate with other Contractors / trades as required for proper installation of interfacing work; and monitoring of such work during placement and finishing of concrete. All interfacing work displaced during concrete placement will be required to be moved to proper location.

D. Subgrade:
01 Prior to placement of slab membrane, inspect the building pad / subgrade and verify that all foreign objects have been removed.
02 Verify that the subgrade is level, compacted and evenly graded. Hand rake where required.
03 Remove all material that could potentially puncture or stress the slab membrane.

E. Drilled Piers:
01 Do not begin drilled pier operations until provisions are in place to assure that placement of reinforcing and concrete shall occur as soon as possible after finishing drilling the pier.
02 In no case shall drilled piers be left open / unfinished overnight.

3.2 INSTALLATION

A. Drilled Piers:
01 When drilled piers are shown to be vertical, bore shafts plumb within tolerance of up to 2" over the length of the shaft.
02 To ensure proper bell / under ream size, use chains as required on the bell auger; or alternatively, use appropriate size bell auger.
03 Install closely spaced piers in alternating sequence as required to prevent caving and / or leakage of concrete.
04 Fill each pier with concrete as soon as practical. Under no circumstances shall drilled piers be left unfilled overnight.
05 Keep bell / under ream base thoroughly clean and free of water before concrete is placed.

06 Fill bell / under ream with concrete and vibrate with a pencil vibrator. Do not over vibrate.

07 After bell / under ream is poured, set reinforcing cage as required to allow for minimum 3" coverage of concrete at base. Dropping reinforcing cages into pier shall not be allowed.

08 Fill pier shaft with concrete up to required elevation. Once placed, consolidate concrete with a pencil vibrator. Do not over vibrate.

B. Forms:

01 Conform to the shapes, lines and dimensions of the members as shown on the drawings, except as modified under Section 31 20 00 – Earth Moving of these Specifications.

02 Care shall be taken to assure that formwork does not stain concrete surfaces.

03 Slab Block-Outs:

a. Diamond configuration at paving drains and building slabs.

b. Coordinate with concrete joints, verify with Architect.

04 Slope exterior concrete slabs away from building and slope interior slabs to floor drains. Verify all slopes with Architect prior to start of concreting.

05 Forms:

a. Grade beams shall be formed to the sizes indicated on the Drawings.

b. Where carton forms are not required, the contractor may omit forms of grade beams provided the grade beam is widened 1 1/2 inches on each side in contact with the earth.

c. The top 12 inches (minimum) of the outside faces of exposed perimeter grade beams must be formed. Unformed perimeter grade beams shall not be allowed above the surface of finish grading.

d. If forms are used, then the widening of the grade beams are not required.

06 Carton Forms: Permitted only if specifically indicated on the Drawings.

a. Where carton forms are required, both sides of the grade beam shall be formed.

b. Fasten carton form in place to eliminate movement / shifting during concrete placement.

c. Take all necessary precautions to keep carton forms dry prior to concrete placement. In the event they become wet, remove and replace with dry, rigid forms.

07 Slab Recesses and Sloped Surfaces:

a. Accurately form all slab recesses to depths indicated on the Drawings.

b. Where Drawings indicate slab(s) to slope, accurately form sloped areas and screed to provide a uniform slope.

c. Contractor shall have the option to form recessed and sloped areas a minimum of 2 inches deeper than indicated and top-out recess at a later date to finished elevations.

08 Form Removal:

a. Ensure safety of the structure.

b. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support their weight and the load thereon.

C. Vapor Membrane:

01 Refer to Section 03 15 19 – Below Slab Vapor Membrane.

02 Verify that vapor membrane installation is 100% complete and approved prior to start of reinforcement installation and / or slab prep work.

03 Immediately repair and / or replace vapor membrane if damaged during

concrete work preparation or placement.

D. Reinforcing:
   01 Cleaning Reinforcement: Free from rust, scale or other coatings which will destroy or reduce the bond.
   02 Placing Reinforcement:
      a. Place accurately and adequately secure in position.
      b. Reinforcement in all concrete slabs shall be held in proper locations by use of plastic chairs spaced a maximum distance of 48 inches O.C., unless noted otherwise.
   03 Coverage of Reinforcement: The metal reinforcement shall be protected by the thickness of concrete indicated on the plans.
      a. 3-inch: Concrete deposited against ground without use of forms.
      b. 2-inch: 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 inch: Bars 5/8 inch diameter where concrete is exposed to the weather, or exposed to the ground but placed in forms.
      d. 3/4 to 1 inch: In slabs and walks not exposed to the ground nor to the weather, not less than 3/4 inch. Increase coverage and slab thickness at auditorium seating to miss seat anchors. Refer to Structural Drawings.
      e. Not less than 1 1/2 inches in beams, girders and columns not exposed to the ground nor to the weather.
      f. 1-1/2 to 1-3/4 inches from top: Paving.
   04 Mesh: Locate as shown on the Drawings. Place on chairs. During concrete placement, verify that mesh is pulled up into concrete pour.

E. Waterstops:
   01 All non-rigid waterstops shall be installed in a continuous keyway cast into the (receiving) concrete. Keyways shall be formed with 2x4's with canted sides to form a trapezoid shape.
   02 Concrete to receive waterstops shall be dry and free of contaminates.
   03 Where required, prime concrete in accordance with manufacturer's standards and recommendations.
   04 Install waterstops in continuous lengths, firmly adhered to receiving concrete surface.
   05 Overlap at splice joints in accordance with manufacturer's standards and recommendations.
   06 Leave protective wrapping in place until ready to cover with fresh concrete.

F. Joints:
   01 Construction Joints:
      a. Floor slabs shall be formed using metal screed joints. Verify locations of all control joints not indicated on the Drawings with the Architect, in ample time to avoid construction delay.
      b. Use at cold joints in building.
   02 Contraction Joints: Refer to Structural Drawings.
   03 Expansion Joints:
      a. Where walks and paving terminates against curbs or buildings, and at sides adjacent to curbs building or walls, whether detailed or not. Verify locations with the Architect if either redwood or asphalt impregnated fiber with sealant cap.
   04 Tooled Joints: Provide scored lines on exterior concrete slabs and walks.

G. Concrete:

01 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 provisions of ASTM C94.

02 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.

03 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. Where a section cannot be placed continuously, provide construction joints.

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 re-handling and 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.

04 Placement Schedule: Place concrete in conformance with a placement schedule to ensure even distribution of loads.

a. Alternate placement to allow for shrinkage.

b. Where construction joints are shown or required, alternate panels, allowing a minimum of 7 days curing time prior to placing adjacent panels.

05 Conveying:

a. Handle concrete from point of delivery and transfer to conveying equipment to the location of final deposit as rapidly as practicable, and by methods which prevent segregation and loss of mix materials.

b. Provide runways for wheeled conveying equipment from delivery point to location of final deposit.

c. Keep interior surfaces of conveying equipment, including chutes and tremies, free from hardened concrete, debris, water and other deleterious materials.

d. Pumps may be used only if they can pump the designed mix. Do not add fine aggregate or water to the mix to satisfy needs of a pumping device.

e. Use chutes or tremies for placing concrete where a drop of 10'-0" or more is required.

06 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 any construction joints, until the placing of a panel or section is completed.

c. Consolidate concrete during placement by use of the specified equipment, thoroughly working concrete around reinforcement and into corners.

d. Consolidate concrete placed in beams and girders of supported slabs and against bulkhead of slabs on grade, as specified for formed

concrete structures.

e. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds or other methods acceptable to the Architect.

f. Limit time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.

g. Bring slab surfaces to correct level with a straight edge, and then strike off.

h. Use bull-floats or darbies to smooth the surface, leaving it free from bumps and hollows.

i. Do not sprinkle water on the plastic surface; do not disturb the slab surfaces prior to start of finishing operations.

07 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.

a. Use of Calcium Chloride, accelerants, or additives shall not be permitted unless there is prior written approval by the Architect and Engineer of Record.

08 Hot Weather Placing: Prepare aggregates, mix water and other ingredients, and place, cure, and protect concrete in accordance with the requirements of ACI-305.

09 Consolidation:

a. Consolidate all concrete footings, piers, grade beams, slabs, paving, etc. in accordance with provisions of ACI-309.

b. Consolidate each layer of concrete immediately after placing, using internal concrete vibrators supplemented by hand-spading, rodding or tamping.

c. During all phases of operation, maintain a frequency of not less than 10,000 vibrations per minute per internal vibrator.

d. Provide adequate number of units and power source at all times. Maintain spare units on hand to ensure adequacy.

e. If, in the opinion of the Architect, the equipment is not adequate to accomplish proper consolidation, he may order delay in further placement until adequate equipment is made available.

f. Maintain vibrators to assure peak efficiency at all times during placement.

H. Colored Concrete – Color Hardener:

01 While concrete is still in the plastic stage of set, apply Bomanite Color Hardener

02 Apply at rate recommended by manufacturer, evenly to the surface of the fresh concrete by the dry-shake method.

03 Apply in two or more shakes, floated after each shake and troweled only after the final floating.

04 Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

05 Apply secondary stain treatment per approved mock-up or as scheduled to achieve design.

06 Apply finish sealer per approved mock-up or as specified to achieve design required.

07 Apply Bomanite recommended Colorwax in accordance with manufacturer's printed instructions in colors to match the colored concrete selected.

I. Wet Curing:

01 All interior slab areas shall be water cured for a minimum of five (5) days.

02 Maintain wetness of slab areas by suitable means (sprinklers, drip hoses, water blankets, etc.) for a minimum of five (5) days.

J. Curing Compound: Concrete work cured with a curing compound shall be performed in strict accordance with the manufacturer's requirements and recommendations.

3.3 FINISHES AND TOLERANCES

A. Finishes – Grade Beams and Vertical Surfaces:
01 Exposed surfaces of all concrete walls and grade beams shall receive a rubbed finish, unless otherwise noted. Immediately after forms are removed, grout pits and recesses and rub with carborundum stone to a smooth finish, free from marks or honeycomb to the Architect's satisfaction. Finish exterior surface 2 inches below finish grade.
02 Rubbed finish shall be of the finest workmanship, with uniform texture and color.
03 Prepare samples for approval of Architect.
04 Protect all rubbed finish against damage during construction period. Immediately before requesting final acceptance of work, the Contractor shall remove protection and do such touch up and rubbing as necessary to leave rubbed surfaces in perfect condition.
05 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.

B. Finishes – Interior Slabs:
01 Spreading of dry cement for finishing is not permitted.
02 Flooding floor is not permitted during finishing. A limited, light / sprinkled application of water shall be permitted.
03 Interior slabs to receive direct applied finish flooring: provide a troweled smooth flat matte finish capable allowing moisture within the slab to escape through capillary pores of the concrete surface.
04 Interior slabs to remain concrete: Provide a smooth, hard troweled finish unless broom finish is indicated on drawings.
05 Moisture mitigation required due to over troweling concrete slabs to the point that moisture is trapped within the concrete slab shall be at the Contractor's sole risk and responsibility; and shall not be at any additional cost to the Owner.
06 Interior slabs to receive thickset / mud-bed finish flooring (mud-set terrazzo, thick-set quarry tile, etc.): floated, smooth finish. Coordinate exact requirements with flooring applicator.
07 Provide broom finish where indicated on drawings.

C. Saw-Cut Joints in Slabs:
01 All joints to be saw-cut in slabs shall occur within six (6) hours of concrete placement.
02 All joints cut into green slabs shall be cut with an early entry saw specifically designed for cutting green concrete.

3.4 FIELD QUALITY CONTROL

A. Testing Laboratory: Perform the appropriate tests upon notification by the Contractor. Refer to Section 01 45 23 - Testing and Inspection Services.

B. Contractor shall take necessary precautions to not over-trowel concrete slabs to the point that the finish closes pores in the concrete.

C. Tolerances – Interior Slabs at Finish Floor to Receive Adhered Flooring Materials:
   01 True to plane within 3/16” over any 10-foot length, non-cumulative; ACI F-32.
   02 Verify any additional requirements with the flooring installer.

D. Tolerances – Recessed Interior Slabs to Receive Composite Wood Flooring Assemblies:
   01 True to plane within 1/8” over any 10-foot length, non-cumulative; ACI F-50.
   02 Verify any additional requirements with the flooring installer.

E. Tolerances – Recessed Interior Slabs to Receive Built-Up or Thick-Set Flooring:
   01 True to plane within 5/16” over any 10-foot length, non-cumulative; ACI F-20.
   02 Verify any additional requirements with the surfacing installer.

F. Exterior Concrete Slabs: Refer to Section 32 13 13 – Concrete Paving and Flatwork.

3.5 PATCHING AND CLEANING

A. After forms are removed, remove projecting fins, bolts, form ties, nails, etc., not necessary for the work, or cut back 1 inch from the surface. Where, in the Architect's opinion, surface defects occur, such as honeycombing, repair the defective areas as directed by the Architect. Joint marks and fins in exposed work shall be smoothed off and cleaned as directed by the Architect.

B. Repair defects in concrete work per ACI-301, Chapter 9, and as directed by the Architect. Chip voids and stone pockets to a depth of 1 inch or more as required to remove all loose material. Voids, surface irregularities, chipped areas, etc., shall be filled by patching, gunite or rubbing, as directed by the Architect. Repaired surfaces shall duplicate appearance of unpatched work.

C. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete to the approval of the Architect.

D. Reinforce or replace any deficient work as directed by the Architect, and at no additional cost to the Owner.

3.6 CLEAN - UP

A. In addition to the requirements of General Conditions, clean up all concrete and cement work on completion of this portion of the work, except protective coating or building papers shall remain until floors have completely cured or until interior partitions are to be installed.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all concrete masonry unit (CMU) masonry work where indicated on the Drawings and as required for a complete installation.
   02 Provide all masonry reinforcing and ties as specified here-in; and required for a complete installation.

C. Related Work:
   01 Section 07 21 00 – Thermal Insulation
   02 Section 07 21 19 – Foamed-in-Place Insulation
   03 Section 07 25 00 – Weather Barrier

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Samples:
   01 Samples of masonry ties proposed to be furnished.
   02 Samples of full range of actual mortar color selections. Paper or digital samples are not acceptable.
   03 Sample of mortar deflector proposed to be furnished.

D. Operations and Maintenance Manuals:
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to Section 01 78 23 – Operations and Maintenance Manuals.
   03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

E. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. American Society for Testing and Materials:

01 ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
02 ASTM C43 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
03 ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
04 ASTM C67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
05 ASTM C90 – Standard Specification for Loadbearing Concrete Masonry Units
06 ASTM C216 – Standard Specifications for Facing Brick.
07 ASTM C476 – Standard Specifications for Grout for Masonry.
08 ASTM C652 – Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
09 ASTM C744 – Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
10 ASTM C140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
11 ASTM D5095 – Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatment
12 ASTM D6490 – Standard Test Method for Water Vapor Transmission of Non-Film Forming Treatments Used on Cementitious Panels
13 ASTM D6532 – Standard Test Method for Evaluation of the Effect of Clear Water Repellent Treatments on Water Absorption of Hydraulic Cement Mortar Specimens

B. Brick Industry Association (BIA).

C. National Concrete Masonry Association (NCMA).

D. National Fire Protection Association (NFPA) 285 – Standard Fire Test Methods for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Materials.

1.4 TESTS AND INSPECTIONS

A. Architect may require tests and inspections as necessary to verify quality and strength of brick materials, mortar, grout, and workmanship.
01 Material tests shall be made on actual materials as they are being installed on the project.
02 Contractor shall coordinate and cooperate with testing lab as required for tests to be conducted.

B. Laboratory tests of materials, mortar, grout and prisms shall be made per ASTM standard procedures.

C. Contractor shall coordinate with testing lab as required to provide the necessary materials and samples.

D. Owner will select Testing Laboratory and Owner will pay for all work required by Testing Laboratory.

1.5 DELIVERY, STORAGE AND PROTECTION

A. Store all materials above the ground to prevent contamination by dirt, rust or other materials which may cause staining or other blemishes and defects.

B. Store concrete and clay masonry units under cover and keep dry until used for installation.

C. Store in manufacturer's original containers until opened for installation.

D. Cementitious materials or admixtures in opened / broken containers or in packaging showing water marks or evidence of other damage shall be removed from the site and not used for installation.

E. Bulk sand used for mixing mortar shall be placed on a waterproof membrane sufficient to prevent intrusion of ground water into the sand; and similarly, shall be covered as required to prevent intrusion of water / rain.

1.6 SITE CONDITIONS

A. Cold Weather Protection: No masonry shall be laid when the temperature of the outside air is below 40°F, unless protection measures are employed and pre-approved by the Architect.

B. Protection measures for cold weather erection include maintaining space and masonry unit temperatures of at least 40°F for 48 hours, prior to and after erection.

1.7 WARRANTY

A. Warrant the masonry work specified herein for two (2) years after Substantial Completion 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:
   01 Noticeable deterioration of masonry unit or mortar finish.
   02 Chalking or dusting excessively.
   03 Changing sheen in irregular fashion.
   04 Efflorescence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Concrete Masonry Units – CMU: Design is based on products manufactured by Best Block Company.
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this Section provided proposed products meet or exceed all specified requirements.
      a. Eagle-Cordell
      b. Featherlite
      c. IPC
      d. Revels Block & Brick Co.

B. Acceptable Manufacturers – Split-Face Masonry Units: design is based on products manufactured by Best Block Company.
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this section provided proposed products meet or exceed all specified requirements.
      a. Oldcastle / Trenwyth.
      b. Acme.

C. Masonry Reinforcement, Anchors and Ties: design is based on products manufactured by Hohmann &Barnard (HB).
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this Section provided proposed products meet or exceed all specified requirements.
      a. Heckmann Building Products (basis of design).
      b. Dayton Superior / Dur-O-Wal
      c. Wire-Bond

D. Mortar Dropping Deflector: design is based on products manufactured by Mortar Net.
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this section provided proposed products meet or exceed all specified requirements.
      a. Hohmann &Barnard (HB) .
      b. Heckman.
      c. Polyguard Products.

E. Weep Hole Inserts: design is based on products manufactured by Hohmann & Barnard (HB).
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this section provided proposed products meet or exceed all specified requirements.
      a. Heckman Building Products.
      b. Advanced Building Products.
      c. Wire Bond.

F. Masonry Cleaning Products: design is based on products manufactured by Prosoco.
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this Section provided proposed products meet or exceed all specified requirements.
      a. CBR Products
      b. Diedrich Technologies
      c. Dumond Chemicals

G. Masonry Water Repellants: design is based on products manufactured by Prosoco.
   01 Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this section provided proposed products meet or exceed all specified requirements.
      a. Tnemec.
      b. United Golsonite Laboratories (UGL).

2.2 MASONRY MATERIALS

A. Concrete Masonry Units:
   01 Face Dimensions: 8" x 16", modular depths (4”, 6”, 8”, 12”) as indicated on Drawings.
   02 Color shall be standard gray at main building.
   03 Comply with ASTM C90.
      a. Grade: N, highest standard
      b. Type: I, Moisture -controlled unit
      c. Aggregate: Lightweight
   04 When tested as a component of a masonry prism, CMU shall have a minimum compressive strength of 1,900 PSI, or higher if indicated on the Structural Drawings.
   05 Provide class D-2 units at 2-hour rated walls; class D-3 at 3-hour rated walls.
   06 Curing: Rotary kiln process.
   07 Provide bullnose units at all outside corners; except at walls to receive ceramic tile finish. Coordinate as required.
   08 Complete with bond beam, control joints, jambs, lintels, soaps and fillers to match and compliment standard CMU.

B. Split Face Concrete Masonry Units – Veneer Application:
   01 Face Dimensions: 4”D x 8"H x 16"L and 8”D x 8”H x 16” L solid split face concrete masonry units as indicated on the Drawings.
   02 Color:
      a. Agricultural Facility: #87 Charcoal
      b. Concessions Building: To be selected by Architect from manufacturer’s standard colors.
   03 All split face CMU shall be manufactured with an integral color throughout.
   04 All split face CMU shall contain an integral water repellant.
   05 Comply with ASTM C90.
   06 Grade: N, highest standard.
   07 Type: I, Moisture -controlled unit.
   08 Aggregate: Lightweight.
   09 Curing: Rotary kiln process.
   10 Provide split face corner units and special shapes as indicated on the Drawings and required for a complete, finished installation.

2.3 MORTAR MATERIALS

A. Type “S” Mortar:
   01 Use at all CMU masonry work.
   02 Hydrated Lime: ASTM C207, TYPE "S"
   03 Portland Cement: ASTM C150, Type 1
   04 Water: Clean and potable
   05 Sand: ASTM C144
   06 Type “S” Mix Design: (Proportions by volume):
      a. Type: ASTM C270, Type "S"
      b. Proportions: 2 parts cement, 1-part hydrated lime and 9 parts sand to provide a compressive strength of 1800 PSI in 28 days.
      c. Mixing: Thoroughly machine-mix for at least 5 minutes after all material is in mixer.
   07 Do not use calcium chloride.

B. Mortar Colors:

01 Provide standard gray mortar for all concealed masonry and masonry to receive a painted finish.
02 Mortar at exposed / unfinished masonry shall be as selected by the Architect from manufacturer's full range of mortar colors – minimum of 12.

C. Site Mixed Mortar:
01 All site mixed masonry components shall be added to mixer using quantifiable mixing containers (i.e. cubic-foot boxes, known quantity liquid devices and similar containers).
02 Adding components by shovel is not permitted.

D. Mortar Deflector:
01 3-dimensional, polypropylene or polyethylene mesh product designed to be a continuous application at the base of a brick ledge.
02 Deflector shall be dual level to eliminate continuous build-up of mortar on the upper edge.
03 Deflector shall fill the width of the brick cavity up to minus (-) 1/2".
04 Deflector shall be non-corrosive.
05 Provide continuous at base of all brick veneer, brick ledges, lintels and metal through-wall flashing conditions.

E. Weep Hole Inserts:
01 Design is based on HB QV-Quadro Vent Weep Hole Insert.
02 Polypropylene honeycomb unit to be installed at brick veneer weep holes.
03 Conforming to ASTM D2240, D790B, D638 and D1238B.
04 Size to fit the head dimension of the brick unit being used.
05 Unit to be installed flush with the exterior face of the veneer.
06 Color to be selected from manufacturer's standard finishes.
07 Provide at all weep holes.

2.4 MASONRY REINFORCING MATERIALS

A. General:
01 All masonry reinforcing shall be hot-dipped galvanized after fabrication in accordance with ASTM A153.
02 All truss type reinforcing shall be fabricated using be 9-gauge rod materials unless noted / specified otherwise.
03 All truss type reinforcing shall be furnished with prefabricated corners and tees to be used where applicable.
04 All truss type reinforcing shall be provided in nominal widths, 2" less than masonry it is being installed in.

B. Truss Type Reinforcing – Single Wythe Masonry:
01 Design is based on HB no. 120 Lox-All Truss-Mesh or 220 Ladder-Mesh Joint Reinforcing.
02 Provide in continuous lengths wherever possible.
03 Spacing: nominal 16" O.C. vertically.

C. Truss Type Reinforcing – Multiple Wythe CMU Composite Walls:
01 Design is based on HB no. 140 Lox-All Truss-Mesh or 240 Ladder-Mesh Joint Reinforcing.
02 Provide in continuous lengths wherever possible.

03 Spacing: nominal 16” O.C. vertically.

D. Truss Type Reinforcing – CMU Back-Up Walls With Brick Veneer:
01 Design is based on HB no. 170 Lox-All Truss Style Adjustable Joint Reinforcement.
02 Provide with 3/16” Eyes and Pintles.
03 Provide pintle length / size as required to extend to 3/4" to 1” from outside face of masonry veneer.
04 Pintles shall allow for a minimum of 1-1/4” vertical adjustment. Provide in greater adjustment configuration where required due to masonry coursing.
05 Provide in continuous lengths in horizontal joints.
06 Spacing: nominal 16” O.C. vertically; eyes and pintles at 16” O.C. horizontally.

E. Masonry Ties – Veneer at Metal Stud Back-Up Walls – With Rigid Insulation:
01 Design is based on HB no. HB-213 series 2-Piece Adjustable Anchors.
02 L-shaped plate bracket; 12 gauge material.
03 Provide with 3/16” pintles.
04 Provide pintle length / size as required to extend to 3/4" to 1” from outside face of masonry veneer.
05 Pintles shall allow for a minimum of 1-1/4” vertical adjustment. Provide in greater adjustment configuration where required due to masonry coursing.
06 Spacing: nominal 16” O.C. vertically; and 16” O.C. horizontally.

F. Masonry Ties – Veneer at Metal Stud Back-Up Walls – Without Rigid Insulation:
01 Design is based on HB no. DW-10HS series 2-Piece Veneer Anchors.
02 Slotted, 5-1/2” long plate bracket; 12 gauge material.
03 Provide with 3/16” triangular wire tie.
04 Provide wire tie length / size as required to extend to 3/4" to 1” from outside face of masonry veneer.
05 Pintles shall allow for a minimum of 1-1/4” vertical adjustment. Provide in greater adjustment configuration where required due to masonry coursing.
06 Spacing: nominal 16” O.C. vertically; and 16” O.C. horizontally.

G. Masonry Ties – Steel:
01 Design is based on HB series 359 2-piece anchors welded to steel structure / components.
02 Provide with 3/16” triangular wire tie.
03 Provide wire tie length / size as required to extend to 3/4" to 1” from outside face of masonry veneer.
04 Pintles shall allow for a minimum of 1-1/4” vertical adjustment. Provide in greater adjustment configuration where required due to masonry coursing.
05 Spacing: nominal 16” O.C. vertically; and 16” O.C. horizontally.

H. Control Joint Anchors:
01 Masonry Veneer Control Joints: design is based on HB Corrugated Control Joint Anchor. Size: 1/2" x 16 gauge.
02 CMU Wall Control Joints: design is based on HB Slip-Set Stabilizer, 2-piece anchor comprised of metal end with two integral 9 gauge rods and a 4” long PVC loose sleeve.

I. All fasteners used to connect masonry ties and similar products through the weather barrier shall be cadmium plated and provided with neoprene washers.

2.5 CMU MASONRY REINFORCING

A. All reinforced CMU masonry reinforced with grade 60 rebar and cells filled with grout.
   01 Grout shall meet or exceed requirements of ASTM C476.
   02 Grout shall be a blend of cement, sand, aggregate and water required to create a flowable mixture.
   03 Grout compressive strength shall be a minimum of 2,000 PSI at 28 days.
   04 Use at all vertical reinforced cells, hollow metal doors frames, bond beams, lintels and other locations indicated on the Drawings or required for a complete masonry installation.
   05 Refer to Structural Drawings for additional information and requirements.

B. Coordinate as required for installation of rebar dowels set in concrete foundation to connect to all CMU vertical reinforced cells.
   01 Unless noted otherwise, rebar dowels for 8” or larger CMU shall be #5 rebar, 30” in length, embedded nominally 12” into concrete foundation.
   02 Unless noted otherwise, rebar dowels for 6” CMU shall be #4 rebar, 30” in length, embedded nominally 12” into concrete foundation.
   03 Reinforcing shall be continuous from slab to top of wall. Splice in accordance with Section 03 30 00 – Cast-in-Place Concrete.
   04 Vertical reinforcing shall tie to reinforcing at bond beams and lintels.

C. Unless noted more stringent on the Structural Drawings, provide reinforcing in vertical CMU cells at the following locations:
   01 General Field / Run of Walls: 48” O.C. maximum.
   02 End of Walls: at end cell.
   03 Wall Corners: at corner cell and adjacent cell each side.
   04 Wall Intersections: two cells at intersection (one each wall).
   05 Openings: at one cell each side of opening.
   06 Expansion / Control Joints: at one cell each side of joint.
   07 Refer to Structural Drawings for additional information.

D. CMU Lintels:
   01 At 6” CMU Lintels: (1) #4 bar and fill with pea gravel concrete or grout.
   02 At 8” CMU Lintels: (1) # 5 bar at 8” / (2) #5 bars at 16” and fill with pea gravel concrete or grout.
   03 At 12” CMU Lintels: (2) # 5 bars and fill with pea gravel concrete or grout.
   04 Lintels shall extend a minimum of 8” beyond openings and tied to vertical cell reinforcing at jambs.

E. CMU Bond Beams:
   01 Provide continuous CMU bond beams at top of, or last full accessible course of all CMU walls.
   02 On walls heights 14’ or taller, provide a bond beam at the mid-point of the wall.
   03 Bond beam reinforcing shall be as described for CMU lintels above.
   04 Bond beams shall be tied to vertical cell reinforcing.

05 Refer to Structural Drawings for mechanical linkage between CMU walls and steel structure.

F. Control Joint Anchors:
01 CMU Control Joints: design is based on HB Corrugated Control Joint Anchor.
02 Material: Type 304 stainless steel
03 Size: 6-1/4" x 1" x 22 gauge
04 Install at all horizontally reinforced joints of CMU.

2.6 MASONRY CLEANING AND PROTECTION

A. Masonry Cleaning Products:
01 Cleaning materials for the purpose of removing excess mortar, job dirt and normal job stains from light colored brick and tile units which are not subject to metallic stains shall be Sure Klean® 600 Detergent manufactured by Prosoco; or approved equal.
a. Specific Gravity: 1.117
b. pH: 0.3 (1:6 dilution)
c. Flash Point: None
d. Freeze Point: -30°F (-34.4°C)
e. Weight/Gal.: 9.3 lbs
02 Cleaning materials for purposes of removing excess mortar, job dirt and normal job stains from brick and tile units which are subject to metallic oxidation stains shall be Sure Klean® Vana Trol® manufactured by Prosoco Co.; or approved equal.
a. Specific Gravity: 1.117
b. pH: 0.3 (1:6 dilution)
c. Flash Point: None
d. Freeze Point: -30°F (-34.4°C)
e. Weight/Gal.: 9.3 lbs
03 Cleaning material for removal of excess mortar and job dirt from brick, concrete, tile and stone surfaces shall be Enviro Klean® Mortar & Grout Remover manufactured by Prosoco Co.; or approved equal.
a. Flash Point: None
b. Specific Gravity: 1.00
c. pH: 1.6 (Dilute 1 pound of powder to 1 gallon of water.)
04 Consult brick supplier/manufacturer to confirm proper selection of cleaning detergent to minimize reaction from metallic or other mineral deposits.

B. Masonry Water Repellant Sealant:
01 Design is based on Prosoco Sure Klean® Weather Seal Siloxane PD.
a. Solids: 4.0% ASTM D5095.
b. Specific gravity: 0.996.
c. Flash point: > 212 degrees f per ASTM D3278.
d. VOC: <30 grams/liter.
02 Water Absorption Reduction Rates:
a. Mortar: 98% minimum per ASTM D6532
b. Brick: 89% minimum per ASTM C67
c. CMU: 95% minimum ASTM C140

PART 3 - EXECUTION

3.1 PREPARATION OF MATERIALS

A. Concrete Masonry Units
   01 Lay out CMU to coordinate with reinforcing dowels in slab, centered in CMU vertical cells.
   02 Where cutting is required, masonry shall be cut with a sharp masonry saw.
   03 Lay out split face masonry to yield a generally uniform appearance, without extreme variations from unit to unit.
   04 Lay out CMU to eliminate installation of small cuts as much as practical.

B. Brickwork:
   01 Dampen brick before laying in a manner consistent with the nature of the brick, the mortar, and the weather conditions.
   02 Lay out masonry to eliminate installation of small cuts as much as practical.

C. Mortar and Grout:
   01 Use suitable containers for material measurement (i.e. metal or wood cubic foot box, graduated bucket, etc.). Measuring sand with a shovel is not acceptable.
   02 Mix a minimum of 5 minutes.
   03 Consistency will completely fill all spaces intended to receive grout.
   04 Use within 2-1/2 hours of initial mixing.
   05 Mortar or grout shall not be used if curing has progressed to yield a stiff consistency or flash set.

D. Reinforcement:
   01 Reinforcement shall be free from lose rust and other coatings that would reduce the bond.
   02 Cut accurately to length and bend by such methods as will prevent injury to the material.

E. Straighten out kinks or bends.

3.2 ALLOWABLE TOLERANCES

A. Maximum Variation from Plumb:
   01 In lines and surfaces of columns, walls and at rises:
      a. 1/4" in 10' (1:480)
      b. 3/8" in 20' (maximum)
      c. 1/2" in 40' (1:960)
   02 For external corners, expansion joints and other conspicuous lines:
      a. 1/4" in 20' (maximum)
      b. 1/2" in 40' (1:960)

B. Maximum variation from level:
   01 1/4" in any 20' (1:480)
   02 1/2" in any 40' (1:960)

3.3 INSTALLATION

A. Contractor shall use all means necessary to ensure all masonry work is adequately braced at all times during erection.

B. General:
   01 Do not use chipped brick or chipped block where exposed to view.
   02 Use masonry saws to cut and fit exposed units.
   03 Lay units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
   04 Do not furrow bed joints.
   05 Stop off horizontal run by racking back in each course; toothing is not permitted.
   06 Adjust units to final position while mortar is soft and plastic.
   07 If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh motor.
   08 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.

C. Metal Door Frames Anchored to Masonry: Fill jamb frames solid with mortar as Work progresses. Install masonry anchors, securing to frame and adjacent vertical reinforcement. Fill head frame solid with mortar prior to installing lintel units.

D. Lintels and Bond Beams: Provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the Drawings. Completely fill lintels and bond beams with pea-gravel concrete. Provide 8-inch bearing at end of lintels.

E. Partitions Tops: Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Section 07 92 00 – Joint Sealants. Anchor top of walls to deck or structure.

F. Brick Ledge and Through Wall Flashing:
   01 Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
   02 Place through-wall flashing on bed of mortar and cover with mortar.

G. Mortar Beds:
   01 Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
   02 Lay units with full mortar coverage on horizontal and vertical / head joints in all courses.
   03 Provide sufficient mortar on ends of masonry unit to fill head joints.
   04 Rock closures into place with head joints thrown against two adjacent masonry units in place.
   05 Do not pound corners or jambs to fit stretcher units after setting in place.
   06 Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.

H. Weepholes:
   01 Provide weepholes in head joints in course immediately above all thru-wall and self-adhered flashing at all exterior brick walls.

02 Leave head joint free and clean of mortar.
03 Spacing:
a. Modular Brick and Stone: 24 inch O.C. maximum.
b. King Size Brick: 30 inch O.C. maximum.
c. CMU: 32 inch O.C. maximum.
04 Keep weepholes and area at flashing free of mortar droppings.
05 Install weep hole inserts at all weep hole head joints.

I. Cavity:
01 The level to which brick cavities shall be free of excess mortar shall be as established and approved on the masonry mock-up wall. Keep masonry cavity clean and free of excess mortar.
02 Carefully lay first course at brick ledge and lintels, making sure that cavity is clean of all excess mortar which my impede the flow of moisture through weep holes.
03 As work progresses, trowel and remove all protruding fins in cavity flat on inner surface of the wythe brick cavity.
04 Take all necessary precaution to not allow excess mortar to drop within cavity from the inner surface of the wythe.
a. Use wood strips with attached wire pulls or other suitable means to collect all loose mortar below the course being laid.
b. Remove all mortar and clean the device at regular intervals while mortar is still elastic and able to be removed without disturbing masonry already laid above it.
05 Cavities shall be inspected and excess mortar within the masonry cavity shall be grounds for removal and replacement of masonry if no other practical means is available to remove excess mortar; all at contractor's expense.

J. Mortar Joints and Patterns:
01 Refer to Drawings for accent coursing.
02 Lay brick in running bond pattern.
03 Lay standard CMU in one-half running bond pattern.
04 Provide flush joints where concealed from view and where dampproofing is scheduled.
05 Provide standard concave tooled joint where masonry is exposed to view for brick and CMU, typically. Provide recessed accent joints in brick where indicated on elevations.
06 All mortar joints to be of consistent size.
07 Refer to the Drawings for paver patterns.

K. Reinforcement/Tie Systems:
01 Completely embedded in mortar or grout.
02 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.
03 Truss reinforcing within each wythe shall be at 16 inch O.C. vertically for exterior wythes and back-up wythes, whether detailed or not.
04 Veneer anchors at sheathing covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws. Spacing shall be 16 inch O.C. horizontally and 16 inch O.C. vertically.
05 Veneer anchors at Interior brick walls with metal stud back up shall be the same as paragraph "2.4F" above, except anchors shall be attached directly to metal stud with cadmium plated sheet metal screws.

06 At intersection of all perpendicular masonry walls provide two vertical rows of corrugated wall ties at 16 inch O.C. vertically (7/8" wide x 16 gauge galvanized steel).
07 In cavity walls with CMU back up, embed truss type horizontal reinforcement with integral wall ties every 16 inches O.C. vertically.
08 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 8 inches. Welded or mechanical connection shall develop the strength of the reinforcement.
09 Corrugated strap ties shall not be used as veneer anchors.
10 Place joint reinforcement in the first two bed joints above and the first two bed joints below masonry openings.
11 Provide masonry ties at floor and roof decks as indicated.

L. Corners: Connect corners with No. 9 galvanized wire or corrugated tie using one tie for each 4 inches of nominal wall thickness.

M. Masonry Joints: Expansion Joints/Control Joints:
01 The mortar joint which stops at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.
02 Place masonry control joints and expansion joints as indicated on the Drawings. If not indicated, place joints at 20'-0" O.C. maximum and at each side of openings. Coordinate with Architect for exact locations.
03 Provide CMU control joints directly over concrete slab control joints. Whenever possible, lay out CMU so that control joint will coincide with CMU module (20' maximum spacing between control joints).
04 Provide masonry joints at structural columns to isolate movement from continuing or intersecting walls and columns.

N. Sealant Joints:
01 Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings.
02 Uniform depth: 3/4 inch
03 Uniform width: not less than 1/4 inch and not more than 1/2 inch.
04 Provide sample for Architect's approval.
05 Refer to drawings for locations and details of accent joints.

O. Mortar Deflector:
01 Provide in continuous lengths at base of all masonry installations including brick ledges, lintels and similar conditions where weep holes are present.
02 Install in accordance with manufacturer's standards and requirements.

3.4 CLEANING

A. At completion of the Work, fill and retool holes in joints of exposed masonry surfaces with mortar.

B. After pointing has set and hardened, clean exposed masonry surfaces with cleaning agent recommended for each type of masonry used.

C. Leave masonry clean, free of mortar daubs and with tight mortar joint throughout.

D. After brickwork is set, protect all edges and corners from damage.

E. The cleaning shall be in accordance with manufacturers printed instructions for type of cleaning agent used.
   01 Use a stiff brush where possible for all cleaning.
   02 If a pressure washer is required, use pressure at 300 PSI or less as required to prevent damage of any kind to masonry (i.e. chipping units or mortar, removing brick texture, etc.).
   03 Keep tip a minimum of 24” from face of wall being cleaned.

3.5 MASONRY WATER REPELLANT SEALER

A. Upon completion of cleaning all masonry surfaces, apply the masonry water repellant sealant material to all masonry surfaces using a low pressure.

B. Application: Before applying, read “Protect” and “Precautionary Measures” sections in the Manufacturer’s Product Data Sheet for Weather Seal Siloxane PD. Refer to the Product Data Sheet for additional information about application of Weather Seal Siloxane PD. Do not dilute or alter.

C. Vertical Application Instructions
   01 For best results, apply protective treatment “wet-on-wet” to a visibly dry and absorbent surface.
   02 Alternate Application Methods:
      a. Spray: Saturate from the bottom up, creating a 4” to 8” (15 to 20 cm) rundown below the spray contact point. Let the first application penetrate for 5-10 minutes. Re-saturate. Less will be needed for the second application.
      b. Brush or roller: Saturate uniformly. Let protective treatment penetrate for 5 to 10 minutes. Brush out heavy runs and drips that don’t penetrate.
      c. Dense Surface Application Instructions: Apply in a single, saturating application with no run down. Back roll all runs and drips to ensure uniform appearance. DO NOT OVER APPLY. One application is normally enough. Always test.
   03 Horizontal Application Instructions:
      a. Saturate in a single application. Use enough to keep the surface wet for 2 to 3 minutes before penetration.
      b. Brush out puddles until they soak in. Treated surfaces dry to touch in 1 hour.
      c. Protect surfaces from rainfall for 6 hours following treatment. Many surfaces need several days to develop full water repellency.

3.6 PROTECTION

A. Cover over all unfinished work at night against the elements with plastic sheet, building paper, heavy canvas or other material approved by Architect to prevent water from entering masonry cavities.

B. Upon completion of masonry work, use all means necessary to protect the masonry installation from damage. If damaged, immediately make all repairs and / or replacements.

END OF SECTION

SECTION 05 21 00

STEEL JOIST FRAMING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide open web steel joists as indicated on the Drawings.
   02 Provide joist girders as indicated on the Drawings.

C. Related Work:
   01 Section 05 12 00 – Structural Steel Framing
   02 Section 05 31 00 – Steel Decking
   03 Section 05 50 00 – Metal Fabrications
   04 Section 07 81 16 – Cementitious Fireproofing

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with structural loads, wind loads and other requirements.
   05 Shop Drawings shall be sealed and signed by a Texas Registered Engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

1.3 REFERENCES

A. ASTM International:
   01 ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.
   02 ASTM A 153/A 153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   03 ASTM A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   04 ASTM A 563 – Standard Specification for Carbon and Alloy Steel Nuts.
   05 ASTM B 695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
   06 ASTM F 436 – Standard Specification for Hardened Steel Washers.
   07 ASTM F 568M – Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.

B. American Institute of Steel Construction (AISC):
   01 AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.

C. Steel Joist Institute (SJI):
   01 Steel Joist Institute (SJI) - Standard Specifications, Load Tables & Weight Tables for Steel Joists and Joist Girders.
   02 SJI - Code of Standard Practice.

D. American Welding Society (AWS):
   01 AWS D1.1 - Structural Welding Code – Steel.

E. Federal Specification: Fed. Spec. TT-P-664 and MIL-P-53030.

F. American Iron & Steel Institute - Design of Cold-formed Steel Structural Members.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of the Steel Joist Institute who regularly produces steel joists of the K, LH, or DLH Series, or joist girders conforming to SJI's Specifications and Load Tables and whose designs have been checked and accepted by the Steel Joist Institute.

B. Design connections under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

C. Perform Work in accordance with SJI, Standard Specification, Code of Standard Practice, Load Tables, and Weight Tables, including headers and other supplementary framing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer of steel joists shall be a member of the Steel Joist Institute.

B. The following manufacturers are acceptable to provide products of this Section provided proposed products meet or exceed all specified requirements.
   01 New Milennium Building Systems
   02 Seyco Joist Company
   03 Vulcraft

2.2 MATERIALS

A. Provide Steel Joists in conformance with SJI - Standard Specifications, Load Tables & Weight Tables for Steel Joists and Joist Girders.

B. Open Web Joists Members, SJI Type, including the following as indicated on the Drawings:
   01 Open Web Steel Joists (K Series).
   02 Longspan Steel Joists (LH Series).
   03 Deep Longspan Steel Joists (DLH Series).
   04 Joist Girders.
   05 Composite Joist (CJ Series).

C. Bridging: Provide bridging of material, size, and type required by SJI Standard Specifications for type of joist, chord size, spacing, and span.

D. Furnish ceiling extensions, where indicated on the Drawings, either extended bottom-chord elements or a separate extension unit to support ceiling construction load indicated on the Drawings. Extend ends to within 1 inch (25 mm) of finished wall surface unless otherwise indicated.

E. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
   01 Finish: Plain, uncoated at joists contained within the building envelope.
   02 Finish: Hot-dip zinc coating, ASTMA153/A153M, Class C at exterior joists indicated to be galvanized.

F. 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.
   01 Finish: Plain, uncoated at joists contained within the building envelope.
   02 Finish: Hot-dip zinc coating, ASTMA153/A153M, Class C at exterior joists indicated to be galvanized.

G. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

H. Welding Materials: AWS D1.1; type required for materials being welded.

I. Finish:
   01 Steel joists and joist girders shall be properly cleaned and primed with one coat of manufacturer's standard shop primer in accordance with the SJI Standard Specifications.

2.3 FABRICATION

A. Open Web Steel Joists:
   01 Top Chords and Bottom Chords: Angles or tees.
   02 End Bearing: Double angles or C-sections.
   03 Bearing Point: Flat bearing surface unless shown otherwise on the Drawings.
   04 Provide joist seat extensions as indicated on the Drawings and as required to properly interface with adjacent work.

B. Bridging:
   01 Provide horizontal bridging as indicated on the Drawings and in accordance with Standards of the Steel Joist Institute.
   02 Anchorage: weld bridging to each joist at each contact point with bottom chord and at spandrel members.
   03 As recommended by joist manufacturer.

C. Design and fabricate steel joist with camber as required to accommodate the imposed dead loads.

D. Shop Painting:
   01 Comply with Fed. Spec. TT-P-636.
   02 Preparation of Steel: Clean, dry free of rust, and mill scale.
   03 After Erection: Immediately touch up scratched and welds with paint equal to shop coat.
   04 Do not shop prime joists to receive direct application of cementitious fireproofing.

PART 3 - EXECUTION

3.1 ERECTION

A. All erection procedures shall comply with Steel Joist Institute's "Code of Standard Practice," unless otherwise indicated or specified.

B. All joist shall be installed parallel and square in configurations as indicated on the Drawings.

C. Coordinate with other trades as required to facilitate angle framed openings through bar joists.

D. Touch up field connections and other damaged areas in shop coat as erection proceeds. Use same material as shop coat.

E. Shop tags shall be removed prior to completion of the project.

F. Coat surfaces to be in contact with mortar, masonry or aluminum using a bituminous coating.

3.2 NOTIFICATION

A. Notify Architect and testing laboratory after all structural steel welds are completed.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

.

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Steel deck for roof.
   02 Welding and accessories for metal deck.
   03 Cutting openings and reinforcing for openings 18 inches and smaller in any dimension.

C. Related Work:
   01 Section 05 21 00 – Steel Joist Framing
   02 Section 05 50 00 – Metal Fabrications

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Detailed Drawings showing layout of form sheets, anchorage details, supplementary framing, openings, special jointing or other accessories.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

1.3 REFERENCES

A. American Iron and Steel Institute (AISI):

01 North American Specification for the Design of Light Gauge Structural Members.

B. Steel Deck Institute (SDI):
01 Design Manual for Composite Decks, Floor Decks and Roof Decks.
02 SDI Standards.

C. ASTM International:
01 ASTM A36: Standard Specification for Structural Steel.
02 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
03 ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
04 ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
05 ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

D. American welding Society (AWS):
01 AWS D1.3 - Structural Welding Code – Sheet Metal.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member in good standing of Steel Deck Institute (SDI).

B. 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 and SDI RDDM Roof Deck Design Manual.

C. Roof Decking:
01 Deck shall meet the minimum design gauge and yield strength specified on the Drawings or meet minimum specified Section properties at specified yield strength.
02 Whenever possible, the deck shall be multi-span.

D. Welding: Qualify procedures and personnel according to AWS D1.3, Structural Welding Code - Sheet Steel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are acceptable to provide products of this Section:
01 A.C.T. Metal deck Supply
02 New Millennium Building Systems
03 Oates Metal Deck and Building Products
04 Vulcraft
05 Whitaker Metal Deck Sales

2.2 MATERIALS

A. Steel Roof Deck - General: Fabricate deck to comply with SDI RD - Standard

for Steel Roof Deck, with the minimum section properties indicated. Deck type and thickness shall be as indicated on the Drawings.

B. Design properties shall be computed in strict accordance with "Specifications for the Design of Light Gauge Structural Members", as published by the American Iron and Steel Institute, and Steel Deck Institute Standards.

C. Provide steel deck cut to required lengths where ever practical.

D. Steel deck shall meet the following finish requirements:
   01 All decks shall be galvanized to conform to ASTM A446.
   02 Steel roof deck and supporting members shall be retouched where shop coat has been damaged due to placing, handling or welding.
   03 Provide vented steel deck at all areas to receive insulating concrete fill.

2.3 ACCESSORIES

A. Manufacturer shall supply all ridge and valley plates, cant strips, sump pans and other accessories which must be attached directly to the steel form in order to provide finished surface for application of fill, roofing accessories and roofing.
   01 Coordinate with other trades as required for exact conditions and requirements.

B. Column closures, end closures, side closures and cover plates shall be the standard type provided by the deck manufacturer unless indicated otherwise on the Drawings.

C. Galvanizing Repair Paint for Roof Decks: High-zinc-dust content paint for re-galvanizing welds in galvanized steel conforming to ASTM A780.

D. Fasteners: As manufactured by Hilti, Buildex, Simpson Strong-Tie or approved equal.

E. Flexible Closure Strips.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not install roof deck until supporting construction is in place.

B. Examine support framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work of this Section.

C. If supporting construction is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Locate deck bundles to prevent overloading of support members.

3.3 INSTALLATION - GENERAL

A. Install deck panels and accessories in accordance with the Contract Documents approved Installation Drawings and requirements of this Section.

B. Place deck panels on structural supports and adjust to final position with ends aligned. Attach firmly to the supports immediately after placement in order to form a safe working platform.

C. Cut and neatly fit deck units and accessories around openings and other work projecting through or adjacent to the decking.

D. Trades that subsequently cut unscheduled openings through the deck are responsible for reinforcing the openings.

3.4 INSTALLATION - ROOF DECK

A. Install and fasten deck and accessories in accordance with the Contract Documents, approved Installation Drawings and requirements of ANSI/SDI RD.

B. End Bearing: Install deck ends over supports with a minimum end bearing of 1-1/2 inches (38 mm) unless otherwise shown on approved Installation Drawings.

C. Side Closures: Fasten to supporting structure and deck in accordance with the Contract Documents, approved Installation Drawings and requirements of ANSI/SDI RD.

D. Ridge and valley plates, flat plates at changes of deck direction and sump pans, shall be fastened to the deck in accordance with the Contract Documents, approved Installation Drawings and requirements of ANSI/SDI RD.

3.5 INSPECTION AND REPAIR

A. Before roof insulation placement, the deck shall be inspected for tears, dents, or other damage that may prevent the deck from acting as a tight and substantial form. Replace decking which has been damaged or permanently deflected.

B. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint.

C. Repair Painting: Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.6 PROTECTION

A. Protect installed products until completion of Project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 05 41 00

STRUCTURAL METAL STUD FRAMING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Light gauge steel framing at all exterior walls, and exterior envelope.
   02 Light gauge structural steel framing at interior locations as indicated on the Drawings.
   03 All comments within this specification section shall be adhered to and included in the design by the Texas registered engineer.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 06 10 00 – Rough Carpentry
   03 Section 09 21 16 – Gypsum Board Assemblies
   04 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's specifications and other data for all products proposed to be furnished as needed to demonstrate compliance with specified requirements.

C. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of framing components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Drawings shall depict all conditions of the building envelope.
   05 Include framing and connection details for all envelope wall conditions (i.e. field of walls, rough openings, and special conditions); complete with fastener size, quantity and installation patterns.
   06 If proposed, clearly indicate proposed adjustments to member sizes as indicated on the Drawings; however, such adjustment shall not deviate to a less gauge or less stringent spacing than what is specified.
   07 Provide calculations demonstrating compliance with wind load and other requirements.
   08 Shop drawings shall be sealed and signed by a Texas registered engineer.

D. Manufacturer's installation instructions for all components and assemblies.

E. Sample Panel: Sample panel shall be 8' long x 6' high panel showing completed exterior light gauge steel framing assembly, complete with exterior sheathing, dampproofing and rigid insulation (where applicable).
   01 Assembly shall include a framed opening.
   02 Coordinate as required with other trades. Refer to Section 04 20 00 – Unit Masonry for additional information.

1.3 QUALITY ASSURANCE AND REFERENCES

A. All materials proposed to be furnished shall comply with the following:
   01 AISI: Specification for the Design of Cold-Formed Steel Structural Members. Latest edition and amendments.
   02 ASTM C955: Standard specification for load bearing (transverse and axial) steel studs, runners (tracks), bracing and bridging for screw application of gypsum board metal plaster bases.
   03 ASTM A653: Steel Sheet, Zinc Coated (galvanized) by the Hot-Dip Process, Structural Quality.
   04 ASTM A924: Steel Sheet, Metallic Coated by the Hot-Dip Process, General Requirements.
   05 ASTM A570: Hot-Rolled Carbon Steel Sheets and Strip, Structural Quality.
   06 ASTM A611: Steel, Cold-Rolled Sheet, Carbon, Structural.
   07 MLSFA: Steel Framing Manual.
   08 Welding Qualifications: Quality welding processes and welding operations in accordance with AWS "Standard Qualification Procedure".

B. The Drawings depict general light gauge steel framing configurations and requirements; and is presumed adequate to permit compliance with the specified performance requirements.

C. Specific design in compliance with this Specification is the responsibility of the light gauge metal framing provider; including, but not limited to:
   01 Member sizes.
   02 Material thicknesses.
   03 Methods and detail of attachment.
   04 Bracing / bridging.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The design of light gauge steel framing is based on products manufactured by ClarkDietrich.

B. The following manufacturers are acceptable to provide products of this Section provided all proposed products meet or exceed specified requirements:
   01 Cemco
   02 Marino/Ware
   03 Mill Steel
   04 The Steel Network
   05 Telling Industries

2.2 MATERIALS

A. Light Gauge Steel Framing:

01 Steel Studs: Manufacturer's standard C-shaped steel studs, punched with stiffened flanges, complying with ASTM C995.

02 Punched web with minimum 1 5/8" flanges with 1/2" inch flange return lip.

03 Steel Track: Manufacturer's standard U-shaped steel track, unpunched, with unstiffened 1-1/4" flanges, complying with ASTM C955.

04 Steel Deflection / Top Track: Manufacturer's standard 16 gauge deep-leg U-shaped steel track, unpunched, with unstiffened 2-inch flanges. Flanges may be slotted to accommodate movement in the stud-to-top-track connection.

B. Provide steel framing accessories of the same material and finish used for framing members, Grade 33.

01 Accessories include bracing, bridging, blocking, gusset plates, diagonal strap bracing, kicker and knee braces indicated, or required to provide a complete steel framing system to withstand design loads indicated on the Structural Drawings.

C. Minimum thickness for any / all light gauge steel framing shall be 54 mil, ASTM A653/A653M, Grade A, 33,000 psi minimum yield (FY).

D. Minimum member size for general framing shall be 6"; unless specifically shown otherwise on the Drawings or required per reviewed Shop Drawings.

E. Minimum Material Thicknesses / Mils for Uncoated Steel:

01 16 gauge: 54 Mil
02 14 gauge: 68 Mil
03 12 gauge: 97 Mil

F. Light Gauge Steel Framing Properties: The following table lists minimum criteria for various member sizes and thicknesses:

	Stud Size	Stud Mil	Min Sx
01	2-1/2"	54	0.306
02	2-1/2	68	0.372
03	3-5/8"	54	0.485
04	3-5/8"	68	0.610
	Note: above only allowed at structural infill, furring and other locations specifically shown on the Drawings.		
05	6"	54	0.953
06	6"	68	1.18
07	8"	54	1.43
08	8"	68	1.77
09	10"	54	1.99
10	10"	68	2.47
11	12"	54	2.62
12	12"	68	3.25

G. Gauge equivalent products shall not be accepted – no exceptions.

H. Light Gauge Steel Framing Properties: The following table lists maximum laterally-unbraced heights for exterior wall framing members spaced 16” O.C. and a maximum deflection of L/360:

	Stud Size	Stud Mil	Max UB Ht.	ClarkDietrich No.
01	6”	54	17’-6”	600S162-54 P
02	6”	68	18’-9”	600S162-68 P
03	8”	54	21’-11”	800S162-54 P
04	8”	68	23’-8”	800S162-68 P
05	10”	54	26’-0”	1000S162-54 P
06	10”	68	28’-2”	1000S162-68 P
07	12”	54	32’-11”	1200S162-54 P
08	12”	68	35’-10”	1200S162-68 P

I. Fastenings:
- 01 Stud-To-Track Fasteners: Self-Drilling Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized ASTM A653 or Dagger-Guard coated.
- 02 Sized and detailed per engineered Shop Drawings.
- 03 Track Anchorage Devices: Power-driven or powder-actuated, drilled expansion bolts; or screws with sleeves; sized and detailed per engineered Shop Drawings.
- 04 Welding: AWS D1.3; sized and detailed per reviewed Shop Drawings.

J. Miscellaneous Materials:
- 01 Provide angle clips, bracing, etc. as required to connect light gauge steel framing to structural steel framing.
- 02 Miscellaneous materials shall be the same gauge, or heavier, as the light gauge steel framing is used on.

K. Finish:
- 01 Provide minimum G60 galvanized coating per ASTM A653 and ASTM C995.
- 02 Touch-up all field welds with inorganic zinc-rich primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal framing systems in accordance with the engineered Shop Drawings and calculations, and manufacturer's installation instructions.

B. Fastening of components shall be by means of approved self-drilling screws or welding.
- 01 Screw and welds shall be of sufficient size to ensure strength of connection.
- 02 All welding shall comply with American Welding Society "Specification for Welding Sheet Steel in Structure".
- 03 All light gauge steel studs shall be fastened to the bottom and top track at both the inboard and outboard track flanges.

C. Runner Tracks: Install continuous tracks to match associated light gauge steel framing members.
- 01 Align tracks accurately to layout at base and tops of studs.

02 Secure tracks as recommended by stud manufacturer, except do not exceed 24 inches O.C. for screw or power-driven fasteners and shall not exceed 16 inches O.C. for other types of attachment.

D. Unless otherwise shown, space studs a maximum of 16 inches O.C.
01 Space studs less than 16” O.C. in accordance with reviewed Shop Drawings.

E. At a minimum, install continuous, horizontal bridging at mid-height in walls up to 10 feet high, and at 5'-0" O.C. maximum in walls over 10 feet high.
01 All bridging shall be welded.

F. Coordinate with other trades as required for proper installation of interfacing work.

3.2 TOLERANCES

A. Install exterior wall framing within 1/4 inch plumb over the full height of the wall.

B. Maintain a straight, true wall within 1/4 inch per 40 linear feet length, non-cumulative.

C. Coordinate exact heights required to accept wood blocking, etc. required for the proper installation and interface with work of other trades.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide miscellaneous metal fabricated materials and assemblies as indicated on the Drawings.
   02 Provide metal fabrications as required to complete all structural steel framing.
   03 Coordinate with other trades as required to provide all necessary metal fabrications required to install and interface with their work.

C. Related Work:
   01 Section 05 52 13 – Pipe and Tube Railing
   02 Section 10 14 53 – Traffic Signage

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements where applicable.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

1.3 REFERENCES

A. ASTM International:
   01 ASTM A36 - Structural Steel.
   02 ASTM A123 / A123M – Standard Specifications for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
   03 ASTM A153 / A153M - Standard Specifications for Zinc (Hot-Dip) on Iron and Hardware.
   04 ASTM A307 - Carbon Steel Externally and Internally Threaded Standard fasteners.
   05 ASTM A385 - Providing High-Quality Zinc Coating (Hot Dip).
   06 ASTM A325 - High Strength Bolts for Structural Steel.
   07 ASTM A500 - Cold formed welded and seamless carbon sheet structural tubing in rounds and shapes.
   08 ASTM A992 - Steel for Structural Shapes for use in Building Framing.
   09 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B. American Institute of Steel Construction:
   01 Steel Construction Manual, 15th Edition.

C. American Welding Society:
   01 American Welding Society Structural Welding Code D11.1-77.

D. American Iron and Steel Institute:
   01 Specification for Design Fabricated and Erection of Cold Formed Steel.

E. Federal Specification: Fed. Spec. TT-P-664 and MIL-P-53030.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS

A. Structural Steel: Comply with ASTM A36.

B. Welding: Comply with American Welding Society Code.

C. Bolts:
   01 Comply with ASTM A307.
   02 Size: 3/4 inch, unless otherwise noted.
   03 Bolts used to fasten roof perimeter blocking to steel framing shall be carriage type bolts.

D. Anchors:
   01 Expansion Bolts:
      a. Rawl Calk-Ins or Arrow Series 4000, 1/4 inch or less.
      b. Rawl Multi-Calks - greater than 1/4 inch. Top shall be 1/2 inch below concrete surface.

02 Molly Screw Anchors:
a. In walls 1/16 - 5/8 inch thick, use "S" length.
b. In walls 5/8 -1 1/4 inch thick, use "L" length.
c. In walls 1 1/4 - 1 3/4 inches thick, use "XL" length.

E. Shop Priming:
01 Shop coat any ungalvanized ferrous metal with primer.
02 Clean iron and metal to be primed of scale, dirt and dust by steel scrapers, wire brushers or sandblasting. Remove oil and grease with petroleum naptha.
03 Thoroughly work paint into all joints by brush. Overall application of brush or spray coat of red lead primer per Fed. Spec. TT-P-86.
04 Give any painted built-in portions one field coat of primer on all abraded parts after installation.

F. Galvanized Metal:
01 Comply with ASTM A123.
02 General: Galvanized all steel sections which are fully or partially exposed to weather, regardless if they are scheduled to receive a finish coat of paint or not.
03 Galvanized items to be painted shall be primed as outlined in Section 09 91 00 - Painting and Staining.
04 Hot-dip galvanized after fabrication.
05 Silicone protective coating shall not be used at galvanized items scheduled to receive paint.

G. Aluminum:
01 Extruded sections from alloy 6063-T52, meeting the requirements of ASTM B221.
Clear anodized finish samples to be submitted for approval on each item. Submit sample of finish weld.
02 Custom fabricate as shown on the Drawings. Grind all welds smooth and flush to match adjoining exposed surfaces. Provide cast wall brackets - Julius Blum #376.
03 All fasteners shall be stainless steel with tamper proof bolts and no pop rivets. Provide flush counter sunk heads.
04 All pipe rails shall be Schedule 40 and have welded connections with male/female splice connections, and have a completely smooth flush finish. All corners and angles shall be custom prefabricated. All splices shall occur at supports.
05 Exterior rails shall be all welded construction.
06 Provide clear epoxy coating where aluminum is in direct contact with concrete (only).

2.2 MISCELLANEOUS METAL ITEMS

A. The following is a list of the principal miscellaneous metal items to be furnished under this Section. This list is offered only as a guide and Contractor shall thoroughly check Drawings for other miscellaneous metals.
01 All steel items exposed to the exterior shall be hot-dip galvanized after fabrication.

B. Fixed Pipe Bollard / Guard Post:
01 Provide and install 4” Schedule 40 steel pipe bollard / guard post, as detailed on the Drawings.
02 Provide casting anchors welded to the bollard as indicated on the

Drawings.

03 Hot dip galvanized after fabrication.

04 Fill with concrete after installation, crowned at top.

C. Removable Pipe Bollard / Guard Post:

01 Provide a 4” Schedule 40 galvanized steel pipe bollard / guard post with 3/8” welded cap plate, as detailed on the Drawings.

02 Provide and install 5” Schedule 40 galvanized steel pipe sleeve in as detailed on the Drawings.

03 Provide casting anchors welded to the bollard sleeve as indicated on the Drawings.

04 Provide 2x2x1/4 x 1-1/2” steel angles on each pipe, positioned to mate at fully installed bollard; angles punched to receive a padlock to prevent removal.

05 Hot dip galvanized after fabrication.

D. Steel Handrails & Brackets:

01 Furnish and install 1-1/2” O.D. Schedule 40 steel pipe rails and handrails in configurations as indicated on the Drawings.

02 Multi component handrail systems shall have welded connections.

03 All exposed open ends shall have welded domed caps.

04 Design of wall brackets is based on Julius Blum # 306 3” offset handrail brackets; or equal approved by the Architect.

05 Maximum handrail bracket spacing shall be 72” unless shown otherwise on Drawings

06 Include all other parts required for finished installation.

07 Handrail assemblies at exterior locations shall be hot-dipped galvanized after fabrication.

08 All work shall be in accordance with ADA and Texas Accessibility Standards.

E. Loose Lintels at Masonry Veneer:

01 Fabricate from steel angles as shown on the Drawings.

02 Refer to Structural Drawings for angle sizes relative to opening widths.

03 Use continuous lengths where ever possible.

04 Hot dip galvanize after fabrication.

F. Masonry Anchors at Steel Columns:

01 Fabricate from 5/16” diameter steel, galvanized after fabrication.

02 Field weld to columns, space not more than 24” O.C. vertically to coincide with horizontal mortar joint elevations.

03 Refer to Structural Drawings.

G. Window Frame Head Supports:

01 Construct frame supports for all aluminum entrances and storefront / curtain walls as detailed and required for a rigid assembly of the aluminum framing.

02 Refer to Structural Drawings.

03 Fabricate and install to provide anchoring of 2x treated wood blocking at head of aluminum entrances and storefront / curtain walls.

H. Miscellaneous Angles:

01 Sizes and shapes as detailed.

02 Use specified galvanized steel for angles at exterior conditions.

I. Below and Above-Ceiling Supports:

01 Construct of Unistrut members or as approved by Architect to size and shape required to mount and support the associated equipment or assembly.
02 Coordinate with other trades as required.
03 Suspended assemblies shall be secured to structure above with minimum 1/4” steel rods; threaded as required.
04 All work shall be accurate to +/-1/4”.
05 Provide supports complete with fastenings to structure for overhead equipment.

J. Hitching Rails:
01 Furnish and install 3” O.D. Schedule 40 steel pipe hitching rails in configurations as indicated on the Drawings.
02 Multi component systems shall have welded connections.
03 All exposed open ends shall have welded domed caps.
04 Maximum post and bracket spacing shall be 48” max.
05 For floor-mounted hitching rails: Install posts into pipe sleeves set in concrete. Grout each post tight with low viscosity epoxy grout.
06 For wall-mounted hitching rails: Provide malleable iron brackets having the mounting hole countersunk for a flat head machine screw to finish flush with the surface. Space brackets no more than 4 feet apart. Anchor returns and brackets with built-in anchor plates.
07 Provide slip flanges where posts are set into concrete and where rails terminate against walls.
08 Include all other parts required for finished installation.
09 Hitching rails shall be hot-dipped galvanized after fabrication.
10 Install at height indicated on drawings. If height is not indicated, install at 48 inches max to comply with TAS accessibility standards.

K. Miscellaneous Items:
01 Miscellaneous metal items and their related components are not necessarily individually described.
02 Miscellaneous items not described shall be furnished and installed in accordance with the intent of the Drawings and Specifications, and as required to complete the Work.
03 Coordinate with other trades as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate all trades as required for proper interface of miscellaneous steel and interfacing work.
01 Concrete foundations at embedded work.
02 Blocking in walls for wall mounted work.
03 Steel supports as required.
04 Coordination with building finishes.

3.2 INSTALLATION

A. Install products in strict accordance with manufacturer’s instructions and final reviewed submittals.

B. Separate all dissimilar metals.

C. Where welding is exposed to view, welds shall be executed neatly then ground

smooth. Pits and blemishes are not acceptable.

D. For manufactured items, adhere to printed manufacturer's installation instructions.

E. Refer to Section 09 91 00 – Painting and Re-painting for items that are to receive paint.

END OF SECTION

SECTION 05 52 13

PIPE AND TUBE RAILING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide exterior pipe handrail and guardrail assemblies at ramps as indicated on the Drawings.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 05 50 00 – Metal Fabrications

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each product proposed to be furnished for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3” x 3”, but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. ASTM International:
   01 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   02 ASTM A123 / 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   03 ASTM A269- Standard Specification for seamless and welded austenitic stainless steel tubing.
   04 ASTM A276- Standard Specification for stainless and heat resisting bars and shapes.
   05 ASTM A312- Standard Specification for seamless and welded austenitic stainless steel pipe
   06 ASTM B26 / B26M - Standard Specification for Aluminum-Alloy Sand Castings
   07 ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
   08 ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
   09 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
   10 ASTM B429- Standard Specification for aluminum structural pipe and tube.
   11 ASTM E894- Standard Test Methods for anchorage of permanent metal railing systems and rails for buildings.
   12 ASTM E935- Standard Test Methods for performance of permanent metal railing systems and rails for buildings.
   13 ASTM E985- Specifications for permanent metal railing systems and rails for buildings
   14 ASTM F3125 - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 KSI and 150 KSI Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

B. American Welding Society (AWS) – Latest Editions:
   01 AWS D1.1 - Structural Welding Code Steel..
   02 AWS D1.2 - Structural Welding Code Aluminum.
   03 AWS D1.6 - Structural Welding Code Stainless Steel.
   04 AWS B2.1-84 - Welding procedure and performance calculations.

C. American Institute of Steel Construction (AISC)
   01 AISC 360-16 - 2016 AISC Specifications for Structural Steel Buildings.

D. Architectural Aluminum Manufacturers Association (AAMA)
   01 AAMA 605.1- Specification for high performance organic coatings on architectural extrusions and panels.
   02 AAMA 606.1- Voluntary guide specifications and inspection methods of

integral color anodic finishes for architectural aluminum.

03 AAMA 607.1- Voluntary guide specifications and inspection methods for clear anodic finishes for architectural aluminum.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS - STEEL

A. Exterior Pipe:
   01 Welded and seamless steel type, ASTM A53, Type S, Schedule 40
   02 Finish: Hot dipped galvanized in accordance with ASTM A123 / A123M.

B. Bolts, Nuts and Washers: High strength steel type, ASTM F3125.

C. Brackets, Flanges and Anchors: Cast or formed metal of the same type of material and finish used for railing.

D. Welding Materials: Applicable AWS D1.1, type required for materials being welded.

E. Finish: Hot dipped galvanized. Do not paint.

2.2 PIPE RAILING SYSTEM

A. Provide in configurations and profiles as indicated on the Drawings.

B. All handrail systems shall be fabricated and installed in accordance with Texas Accessibility Standards (TAS) and Americans With Disabilities Act (ADA).

C. Posts, Top Rail and Handrails: 1-1/2" diameter

D. Infill Horizontal Diagonal Rails: 1 1/4” diameter

E. Wall Brackets: Design is based on products manufactured by Wagner; or equal as accepted by the Architect
   01 Wall Brackets: design is based on Wagner model RB14130 style wall mount handrail bracket in material to match handrail system materials.
   02 Pipe Brackets: provide similar style as wall brackets, specifically configured to mount / adapt to mounting on pipe rail.
   03 Type: 5/8” diameter bar bend
   04 Projection: 3-1/4” from wall to center of handrail
   05 Finish: Match handrail system finish

F. Maximum post spaces shall be 48” unless shown otherwise on the Drawings.

G. Provide pipe sleeves at Removeable portions of railing as indicated on the documents
   01 Metal railing shall fit snugly into sleeves
   02 Install in low viscosity epoxy grout

2.3 GENERAL FABRICATION

A. Verify dimensions on site prior to shop fabrication.

B. Fabricate integral railings and component connections capable of resisting a

lateral force of 250 lbs. minimum, at any single point, without permanent set or damage.

C. Fit and shop assemble sections in largest practical sizes.

D. Accurately form and fit components and connections.
   01 All steel connections shall be cut to fit and welded continuous
   02 Grind exposed edges and welds smooth and flush.
   03 All aluminum connections shall be fitted with flush connectors or welded.

E. Accurately form components required for proper anchorage of stairs, landings and integral railings to each other and to building structure.

F. Thoroughly clean steel surfaces of rust, scale, grease, and foreign matter prior to prime painting. Allow to dry thoroughly before applying priming materials.

PART 3 - EXECUTION

3.1 ERECTION

A. Erect handrails square, level, plumb and free from distortion or defects detrimental to appearance and performance.

B. Provide necessary anchors, plates, and sleeves as required for connecting handrail to the structure.

C. Ensure alignment with adjacent construction. Coordinate with related work to ensure no interruption in installation.

D. Perform necessary cutting and altering for the installation of work of other sections. Do not perform any other additional cutting without the review of the Architect.

E. Field bolt and weld to match standard of shop bolting and welding.
   01 Conceal bolts and screws whenever possible.
   02 If bolts and screws are not concealed, use flush countersunk fastenings.
   03 Make mechanically fastened joints flush (hairline or better).
   04 Grind welds smooth and flush.

END OF SECTION

SECTION 06 10 13

ROUGH AND FINISH CARPENTRY

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide blocking in metal framed drywall partitions and other assemblies as required for the secure attachment of built-in assemblies / products and assemblies / products that anchor to drywall partitions.
   02 Provide blocking at all door and window openings in exterior walls as indicated on the Drawings
   03 Coordinate with all trades and material suppliers to ascertain blocking requirements.
   04 Provide finish wood materials as required in documents.

C. Related Work:
   01 Division 7 - Roofing and Roof Accessories
   02 Division 8 – Doors, Windows and Glazing
   03 Section 12 32 16 – Manufactured Plastic Laminate Clad Casework (Educational)

1.2 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer’s literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Test Reports: Certified test reports showing compliance with the specified performance characteristics and properties.

D. Certificates: Certification from the treatment plant certifying wood treatment applied complies with the criteria and physical requirements for ACQ preservative-treated wood products as specified herein.

E. Shop Drawings:
   01 Complete shop drawings for the Architect's approval.
   02 Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   03 Manufacturer's installation instructions.

1.3 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 structurally 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)
   01 U.S. Dept. of Commerce Product Standards
   02 American Wood Preservers Assoc. Standards (as they apply)
   03 Architectural Woodwork Institute "Quality Standards"
   04 Western Wood Products Association Manual

E. Architectural Woodwork Institute "Quality Standards".

F. National Fire Protection Association
   01 NFPA 285 – Standard Fire Test Methods for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Materials

G. Western Wood Products Association Manual.

H. American Wood Preservers Association Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:
   01 Framing lumber including interior studs, joists, rafters, blocking, etc., #1 kiln dried.
   02 Treated No. 2, S4S Southern Yellow Pine:
      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.

B. Fire Retardant No. 2, S4S Southern Pine: 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 C-20.

C. Preservative Wood Treatment:
   01 Wood products shall be treated with waterborne, alkali-based wood preservatives listed in Section 4 of AWPA Standards U1, excluding those which contain arsenic and / or chromium.

02 All treated wood products not in direct contact with the ground / earth shall meet requirements standards of the American Wood Preservers Association (AWPA) Standard U1 for Use Category 4A.
03 Copper Azole Type-C (CA-C) with minimum treatment rate of 0.15 PCF.
04 Micronized Copper Azole (MCA) with minimum treatment rate of 0.15 PCF.
05 Use galvanized fasteners where not exposed to direct moisture. Use stainless steel fasteners where exposed to direct moisture.

D. Fire Retardant Pressure Treatment of Lumber and Plywood
01 Lumber: Comply with AWPA U1 UCFA, Type A or ICC-ES ESR 2645.
02 Plywood: Comply with AWPA U1, UCFA, Type A or ICC-ES ESR 2645.
03 Surface Burning Characteristics: UL FR-S rating; or flame spread and smoke developed ratings of 25 or less in a test of 30 minutes' duration in accordance with IBC section 2303.2.
04 Kiln dry after treatment to 19 percent maximum moisture content for lumber and 15 percent for plywood
05 Treatment: Viance “D-Blaze FRT”; Dricon “Dricon FRT”; or approved equal.
06 Provide fire retardant wood where ever part of a fire rated assembly; where required by code; and where required by local jurisdiction.
07 Provide fire retardant wood in exterior wall assemblies as required to meet NFPA 285 requirements.

E. Treated Wood Isolation: All treated material shall be installed with an isolation sheet between the wood and adjacent metal surface.
01 Provide 15 lb. asphalt impregnated building felt or other isolation material as recommended by the treatment manufacturer.

F. Interior Trim:
01 Natural: Premium sliced Red Oak conforming to AWI Quality Standard 300-3 for transparent finish. Boards shall be selected for compatibility of grain. No mineral streaks permitted. Use for miscellaneous natural finish trim.

G. Plywood:
01 General: Comply with APA Standards.
02 APA A-D, Group 1 Interior. Used where appearance of only one side is exposed to view for interior locations.
03 Exterior plywood, Group 1, APA rated sheathing. Use where miscellaneous plywood is exposed to concrete or weather.
04 Fire Retardant Treated Plywood - Identical to "C.03" with pressure-impregnated non-combustible fire retardant chemicals in accordance with U.S. FRS Fire Hazard Classification, AWPA Standards C-27. Use when required by building code or noted on drawings.
05 Flooring Underlayment: APA rated Sturdi-floor, exterior grade, tongue and groove edges.

H. Rough Hardware:
01 Nails, Spikes, and Staples:
a. Galvanized for exterior locations, high humidity locations, treated wood not directly exposed to moisture, and fire retardant treated wood.
b. Type 304 or 316 stainless steel for for treated wood directly exposed to moisture.

c. Plain finish for other interior locations.
d. Use largest size and type to suit application.

02 Bolts, Nuts, Washers, Lags, and Screws:
a. Medium carbon steel, A-307 or A-325; size and type to suit application if not noted on the Drawings.
b. Galvanize for exterior locations, high humidity locations, treated wood not directly exposed to moisture, and fire retardant treated wood.
c. Type 304 or 316 stainless steel for treated wood directly exposed to moisture.
d. Plain finish for other interior locations.
e. Carriage bolts shall be used to connect roof edge wood blocking to the steel perimeter angle.

03 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.

I. Sheet metal Blocking:
01 Sheetmetal blocking may be an acceptable alternative to wood blocking for wall attached equipment and assemblies.
02 Minimum Size: 16 gauge x 6” height sheetmetal.
03 Pre-galvanized or hot-dipped galvanized material.
04 Sheetmetal blocking shall be continuous, and extend to the next stud beyond the equipment or assembly.

J. Technology / Punch-Down Boards:
01 Use grade stamped DFPA, grade A/D.
02 Provide 4' x 8' sheets of 3/4 inch plywood for telephone boards in mechanical rooms; telephone rooms and other areas where needed for attachment of equipment of other trades.
03 Provide 3/4 inch plywood up to 8’-0” above finish floor behind finished gyp board at all walls of the technology Head End Room (alternate names include M.D.F. Room, Building Demarcation Room)
04 Provide 3/4 inch plywood up to 8’-0” above finish floor behind finished gyp board at all wall(s) in IDF Rooms where wall mounted equipment is indicated..
05 Where exposed, paint as scheduled in Section 09900

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Blocking in metal framed drywall partitions shall be required at, but not limited to the following locations:
01 All recessed or semi-recessed equipment and assemblies
02 All wall hung surface equipment and assemblies.
03 All wall attached equipment and assemblies.

04 Other equipment or assemblies as recommended by the manufacturer for proper installation.

B. Wood Blocking:

01 Use standard 2x lumber materials for blocking, nailers and other similar applications. Provide 1x materials where indicated or necessary to achieve the required thickness.

02 Rip, chamfer and / or cut material as required fit the application / assembly.

03 Non-continuous blocking supporting continuous 2x blocking or nailers shall be a minimum of 16” long and installed so the maximum gap is 24”.

04 Blocking at all recessed equipment and fixtures shall be continuous all sides.

05 Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.

06 Blocking Locations: Provide wood blocking at all built-in work, in walls for anchoring cabinets, and other locations as indicated on the drawings.

07 Provide blocking, bucks and framing as necessary and for other trades as required.

C. Roof Edge Wood Blocking:

01 Provide continuous wood blocking at roof perimeter as indicated on the Drawings.

02 Anchor to steel perimeter angle at 24” O.C. maximum using a 3/8” minimum carriage bolt, inserted from the underside of the perimeter angle.

03 Counter-sink wood blocking 3/4" maximum depth to accommodate the bolt washer, nut and any protruding thread.

04 Size length of bolt to not protrude above the top surface of the wood blocking.

D. Plywood:

01 Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.

02 Install underlayment plywood in accordance with instructions of American Plywood Association.

03 Space panel joints and edges 1/32 inch.

04 Fill and sand panel edge joints, surface roughness, and damaged or open areas.

05 Fasten with screws spaced at 6 inches at edges and 8 inches in field each way.

E. Sheet metal Blocking

01 Contractor shall submit requested locations or conditions proposed to use sheetmetal blocking to the Architect for review and acceptance.

02 Where accepted, sheetmetal blocking shall be fastened / screwed to each metal stud in a minimum of two (2) locations per stud. Use standard drywall screws for fasteners.

F. Spiking and nailing shall be done using largest size spikes and nail practicable.

G. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on Plans.

H. Provide solid wood blockings between metal stud framing for wall-mounted items, such as toilet partitions, toilet accessories, cabinets, handrail's, etc.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all thermal batt / roll insulation at light gauge metal framed exterior walls and building envelope.
   02 Provide rigid foam insulation on all exterior CMU back-up walls.
   03 Provide rigid foam insulation on sheathing of all exterior light gauge metal framed walls.
   04 Provide thermal batt / roll insulation at metal building system.
   05 Provide metal building roof insulation at metal building system.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 05 41 00 – Structural Metal Stud Framing
   03 Division 7 – Roofing
   04 Section 07 25 00 – Weather Barrier
   05 Section 09 21 16 – Gypsum Board Assemblies

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop Drawings shall be sealed and signed by a Texas Registered Engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.

02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

F. Sample / Mock-Up Panel: Sample / mock-up panel shall be 8' long x 6' high panel showing selected color range and texture, bonding, mortar color, joint shape, and quality workmanship. Include a brick expansion joint. Sample panel shall remain at the jobsite until all masonry is completed.
01 Panel shall be "L" shaped (4' x 4') with metal stud / drywall back-up wall on one side and CMU back-up on one side. Coordinate as required with other trades.
02 Once accepted by the Architect, the sample panel shall be the standard by which installed is judged.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
01 ASTM C209 – Standard Test Methods for Cellulosic Fiber Insulating Board.
02 ASTM C272 – water Absorption of Core Materials for Structural Sandwich Constructions.
03 ASTM C518 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
04 ASTM C578 – Rigid, Cellular Polystyrene Thermal Insulation.
05 ASTM C665 – Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
06 ASTM D1621 – Compressive Properties of Rigid Cellular Plastics.
07 ASTM D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
08 ASTM D1929 – Standard Test Method for Determining Ignition Temperature of Plastics.
09 ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
10 ASTM E96 – Water Vapor Transmission of Materials.

B. Underwriters Laboratory (UL):
01 UL 723 – Surface Burning Characteristics of Building Materials.

C. National Fire Protection Association (NFPA):
01 NFPA 259 – Standard Test Method for Potential Heat of Building Materials.
02 NFPA 285 – Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

PART 2 - PRODUCTS

2.1 MATERIALS – BATT OR ROLL - THERMAL

A. Design of batt or roll thermal insulation is based on products manufactured by Owens-Corning.

B. The following manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 Certainteed
   02 Guardian Building Products
   03 Johns Manville
   04 Knauf Insulation
   05 United States Gypsum

C. Design of batt or roll thermal insulation is based on Owens-Corning Eco-Touch Unfaced Insulation.

D. Batt or Roll Thermal Insulation:
   01 Inorganic glass fiber, flexible, unfaced insulation.
   02 R-Values: minimum R+19 at exterior walls at light gauge steel framed walls.
   03 Comply with Type 1 ASTM 665-84 unfaced.
   04 Flame Spread 25 or less.
   05 Provide in widths to match spacing of light gauge steel framing.
   06 Pins and disc securement accessories. Provide a minimum of two (2) pins at the top of each section of insulation to prevent sagging.

2.2 MATERIALS – CONTINUOUS RIGID INSULATION

A. Design of continuous rigid insulation is based on products manufactured by Atlas Roofing.

B. The following manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 Dow Chemical Co.
   02 Johns Manville
   03 Owens-Corning
   04 Pactiv / Green Guard
   05 Rmax

C. Metal Panel Veneers: Design of continuous rigid insulation is based on Atlas Roofing Energy Shield Pro Rigid Insulation.
   01 This product shall be used behind all metal panel veneer walls.
   02 Closed cell, polyisocyanurate (polyiso) foam core faced with a reflective 12 mil reinforced foil facers on one side and a white 12 mil reinforced acrylic-coated aluminum facer on the other.
   03 Classified Type X in accordance with ASTM C578.
   04 Certified to comply with NFPA 285 in assemblies shown.
   05 Minimum thickness: 1-1/2”
   06 Aged thermal resistance: R-5.0 per inch minimum.
   07 Flame Spread: Class A flame spread, <25 ASTM E84.
   08 Smoke Development: <450 ASTM E84.
   09 Size at light gauge steel framed back-up walls: 4’ x 8’ sheet size. Minimize joints as much as practical.
   10 CMU back-up walls: Width to fit between vertical spacing of masonry reinforcement.

D. Masonry / Stone Veneers: Design of continuous rigid insulation is based on Atlas Roofing Energy Shield CGF Rigid Insulation.
   01 This product shall be used behind all masonry / stone veneer walls.
   02 Closed cell, polyisocyanurate (polyiso) foam core faced with a reflective 12 mil reinforced foil facers on one side and a white 12 mil reinforced acrylic-coated aluminum facer on the other.
   03 Classified Type X in accordance with ASTM C578.
   04 Certified to comply with NFPA 285 in assemblies shown.
   05 Minimum thickness:
   06 Aged thermal resistance: R-5.0 per inch minimum.
   07 Flame Spread: Class A flame spread, <25 ASTM E84.
   08 Smoke Development: <450 ASTM E84.
   09 Water vapor transmission: 0.1 perm maximum.
   10 Size at light gauge steel framed back-up walls: 4’ x 8’ sheet size. Minimize joints as much as practical.
   11 CMU back-up walls: Width to fit between vertical spacing of masonry reinforcement.

E. Rigid Board Insulation Adhesive:
   01 Provide manufacturer’s recommended adhesive for substrate being applied.
   02 Verify compatibility with weather barrier materials.

2.3 MATERIALS – METAL BUILDING SYSTEM ROOF INSULATION

A. Insulation assembly shall consist of a top layer R-19 faced batt insulation conventionally installed over the roof purlins and between the roof purlins and roof panel.

B. Exposed insulation to be faced with a white polypropylene/scrim/core/metalized polyester, complying with ASTM C1136, Type 1, Type “WMP-50” Facing, as manufactured by Lamtec Corporation.
   03 White Film: Polyporpylene 0.0015 inch (face white side towards inside)
   04 Adhesive: Flame Resistant
   05 Reinforcing: Tri-directional Fiberglass/Polyester
   06 Core: 30 lbs./3000 sq. ft.
   07 Adhesive: Polymeric
   08 Film: Metallized Polyester 0.0005 inch
   09 Flame Spread – (ASTM E84): complies

C. Secured with vapor barrier adhesive and double-sided matching vapor barrier tape at joints.

2.4 MATERIALS – METAL BUILDING SYSTEM THERMAL BREAKS

A. Closed cell polyethylene foam tape installed at wall girts. Complies with the follows:
   01 0.125” thick to 0.375” thick
   02 3.01” wide

B. Thermal spacer blocks installed on roof purlins. Complies with the following:
   01 Extruded or expanded polystyrene
   02 Minimum width 3.0”
   03 Thickness 0.5” – 1.0”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Batt or Roll Thermal Insulation:
   01 Batts shall fit between studs and provide full coverage at exterior building envelope.
   02 Install in continuous lengths where ever possible.
   03 Install adhesive-mounted spike devices with metal caps at 2'-0" vertically, and 4 inches horizontally from each side of the blanket.
   04 Install blankets with long dimensions running vertically on spikes, keeping blankets tight to exterior wall without crushing.
   05 On the exterior side of all structural steel located directly behind sheathing.

B. Batt or Roll Acoustical Insulation:
   01 Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.
   02 Install in continuous lengths where ever possible.
   03 Install adhesive-mounted spike devices with metal caps at top of each blanket, and 4 inches horizontally from each side.
   04 Suspend blankets 1” above finish floor.

C. Rigid Board Insulation:
   01 Install board insulation at exterior masonry walls between masonry reinforcement in accordance with manufacturer’s printed instructions. Do not bend or alter masonry ties to secure rigid insulation in place.
   02 Install board insulation on dampproofed sheathing at all light gauge steel framed walls.
   03 Secure insulation boards to back up surface with manufacturer’s recommended adhesive that is compatible with weather barrier product.
   04 Install with joints tight to provide full coverage.
   05 Cope / cut insulation to fit irregularities, masonry ties and obstructions as required to achieve full coverage.
   06 Take precautions to assure that insulation board is concealed within cavity wall construction.

3.2 PROTECTION

A. Upon completion of batt insulation, use all means necessary to protect material from becoming wet.
   01 In the event batt or acoustical insulation comes in direct contact with moisture or becomes wet, remove and discard, and replace insulation with dry material.
   02 In the event batt insulation becomes damp or moist, thoroughly dry insulation prior to covering up.
   03 Use all means necessary to assure that batt and acoustical insulation is completely dry at the time of cover-up and will not promote the growth of mold.

B. Protect rigid insulation as required to prevent damage and delamination.

END OF SECTION

SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide foam-in-place masonry insulation, completely filling cells of all CMU exterior back-up walls, at locations indicated on drawings.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 07 21 00 – Thermal Insulation
   03 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
   01 Product data shall include test certificates / reports, other certifications and applicable documentation to demonstrate compliance and as required by the specification.

C. Installation Instructions: Submit manufacturer's complete installation instructions for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface with adjacent assemblies / materials depicted in the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

D. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.

E. Installer Certification: Provide letter from manufacturer, signed by an officer, stating the installer is licensed and / or certified by the manufacturer to provide the installation.

1.3 REFERENCES - OPEN-CELL, POLYURETHANE FOAMED-IN-PLACE INSULATION

A. American Society for Testing and Materials (ASTM):

01 ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
02 ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
03 ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
04 ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
05 ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
06 ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
07 ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
08 ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
09 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
10 ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
11 ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

B. National Fire Protection Association:
01 NFPA 285 – Standard Fire Test Methods for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Materials.

1.4 REFERENCES - FOAMED-IN-PLACE CMU INSULATION

A. American Society for Testing and Materials (ASTM):
01 ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
02 ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
03 ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
04 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
05 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
06 ASTM E413 - Classification for Rating Sound Insulation.

B. National Fire Protection Association:
01 NFPA 285 – Standard Fire Test Methods for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Materials.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with a minimum of ten (10) years of experience manufacturing products in this Section shall provide all products listed.

B. Installer Qualifications: Products listed in this Section shall be installed by a single organization with at least five (5) years of experience successfully installing insulation on projects of similar type and scope as specified in this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - FOAMED-IN-PLACE MASONRY INSULATION

A. Design for open cell, foamed-in-place polyurethane insulation is based on Tailored Chemical Products Core-Fill 500 insulating foam specifically designed for application in CMU cells.

B. Other Acceptable Manufacturers: the following manufacturers are acceptable provided proposed products meet all attributes and performance characteristics of the basis of design product.
   01 cfiFOAM, Inc.
   01 Polymaster

2.2 MATERIALS - FOAMED-IN-PLACE MASONRY INSULATION

A. General: Foamed-in-place masonry insulation shall be a two-component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.
   01 Provide insulating materials that comply with requirements indicated for materials, compliance with referenced standards, and other specified characteristics.

B. Physical and Mechanical Properties:
   01 Thermal Performance: Minimum “R” value of 4.7 per inch at 35°F when tested in accordance with ASTM C117.
   02 Sound Abatement: Minimum STC rating of 52 for 8” CMU and 54 for 12” CMU.

C. Surface Burning Characteristics:
   01 Flame Spread: 5 or less.
   02 Smoke Developed: 50 – 100.
   03 Fuel Contributed: 0.

D. Combustion Characteristics: Must be non-combustible, Class A building material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Foamed-in-Place CMU Insulation:
   01 Examine CMU walls to determine whether there are conditions that would adversely affect the installation and performance of the insulation.
   02 Walls to be insulated must be free of moisture both inside and outside of the CMU.

3.2 PREPARATION

A. Foamed-in-Place CMU Insulation:
   01 Coordinate with Contractor / other trades to verify locations of horizontal bond beams and other locations which would obstruct the flow of insulation within the CMU vertical cell cavities.
   02 Lay out injection holes as required to assure complete filling of CMU vertical cell cavities.
   03 If top-filling CMU vertical cell cavities, coordinate installation as required to meet manufacturers recommendations and standards for installation.

3.3 INSTALLATION - FOAMED-IN-PLACE CMU INSULATION

A. Install in accordance with manufacturer's instructions. Product must be installed according to local code and must be applied by a qualified applicator.

B. Fill all open vertical cell cavities and voids in exterior CMU back-up walls.

C. On Completed Walls: The foam insulation shall be pressure injected through a series of 5/8" to 7/8" holes drilled into every vertical column of block cells (every 8" on center) beginning at an approximate height of four (4) feet from finished floor level.
   01 Repeat this procedure at an approximate height of ten (10) feet above the first horizontal row of holes (or as needed) until the void is completely filled.
   02 Patch holes with mortar and score to resemble existing surface.

D. Filling from Top of Wall: Provide foaming equipment that can be inserted to the bottom of the cavity and retracted as foam injection progresses.
   01 Fill walls prior to placement of bond beams and lintel beams that would impede placement of insulation below.
   02 Adhere to manufacturer’s standards and recommendations for phasing as required to assure complete filling of all CMU vertical cell cavities.

3.4 PROTECTION

A. Upon completion of foamed-in-place insulation, remove all excess insulation from that may impede the proper installation of adjacent materials and assemblies.

B. Upon completion of foamed-in-place insulation, use all means necessary to protect material from damage and deterioration.
   01 In the event of damage, make all necessary repairs and / or replacement of insulation as required to provide complete, full thickness coverage at all exterior framed walls.

END OF SECTION

SECTION 07 25 00

WEATHER BARRIER

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work: Provide a complete integrated system of components specifically designed to provide a complete fluid-applied membrane air barrier at the building envelope walls. System shall include:
   01 Fluid-applied membrane air barrier suitable for application on gypsum board substrates.
   02 Joint reinforcement, tape, compound and treatment.
   03 Elastomeric flashing.
   04 Sealant.
   05 Adhesives and Primers.
   06 Other components as required for a complete installation as recommended by the manufacturer.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 05 41 00 – Structural Metal Stud Framing
   03 Section 06 10 13 – Carpentry Rough & Finish
   04 Section 07 21 00 – Thermal Insulation
   05 Section 07 65 26 – Self-Adhering Sheet Flashing
   06 Section 09 21 16 – Gypsum Board Assemblies

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit Shop Drawings showing:
   01 Locations and extent of vapor permeable air barrier assemblies.
   02 Details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged.
   03 How inside and outside corners are negotiated, how materials that cover the vapor permeable air barrier are secured with air-tight condition maintained.
   04 How miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Submit documentation from an approved independent testing laboratory certifying the air leakage rates of the air barrier membranes assembly, including primary membrane, primer and sealants have been tested to meet ASTM E2357.

F. Submit documentation from an approved independent testing laboratory certifying the air leakage and vapor permeance rates of the air barrier membranes, including primary membrane and transition sheets, exceed the specified requirements and in accordance with ASTM E2178.
   01 Test report submittals shall include test results on porous substrate and include sustained positive and negative wind load and gust load air leakage results.

G. Manufacturer Certifications signed by manufacturer:
   01 Certifying their review of the project Shop Drawings and that the air barrier system complies with specified requirements.
   02 Certification of compatibility with specified rigid insulation, Section 07 21 00 – Thermal Insulation and Section 07 65 26 - Self-Adhering Sheet Flashing.

H. Manufacturer's Field Service:
   01 Provide site reports from authorized field service representative, indicating observation of fluid-applied membrane air barrier system installation.
   02 Reports shall be required on a weekly basis (minimum) throughout the installation phase(s).
   03 Following completion of Work, submit manufacturer's report of final inspection and acceptance of completed installation.

I. Sample / Mock-Up Panel: Sample / mock-up panel shall be 8' long x 6' high panel showing selected color range and texture, bonding, mortar color, joint shape, and quality workmanship. Include a brick expansion joint. Sample panel shall remain at the jobsite until all masonry is completed.
   01 Panel shall be "L" shaped (4' x 4') with metal stud / drywall back-up wall on one side and CMU back-up on one side. Coordinate as required with other trades.
   02 Once accepted by the Architect, the sample panel shall be the standard by which installed is judged.

J. Operations and Maintenance Manuals:
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to Section 01 78 23 – Operations and Maintenance Manuals.
   03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

K. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   01 AMMA 2400-02, Standard Practice for Installation of Windows with a Mounting Flange in Stud Frame Construction.

B. American Society for Testing and Materials (ASTM):
   01 ASTM D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
   02 ASTM D471, Standard Test Method for Rubber Property - Effect of Liquids.
   03 ASTM D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
   04 ASTM D2243, Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings.
   05 ASTM D5590, Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.
   06 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   07 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.
   08 ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   09 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
   10 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   11 ASTM E1354, Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter.
   12 ASTM E1677, Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.
   13 ASTM E2112, Standard Practice for Installation of Exterior Windows, Doors and Skylights.
   14 ASTM E2178, Standard Test Method for Air Permeance of Building Materials.
   15 ASTM E2357, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

C. National Fire and Protection Agency (NFPA):
   01 NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Manufacturer shall demonstrate a minimum of ten (10) years of experience in fluid-applied membrane air barriers.

B. Applicator Qualifications:

01 The applicator of the fluid-applied membrane air barrier material specified herein shall be a manufacturer's licensed / authorized applicator.
02 Applicator shall have a minimum of five (5) years of experience in the application of fluid-applied membrane air barrier.

C. Source Requirements: Obtain primary materials from a single manufacturer regularly engaged in manufacturing vapor permeable air barrier materials. Obtain secondary materials from a source acceptable to the primary materials manufacturer.

1.5 WARRANTY

A. Warranty:
01 Manufacturer's standard warranty for fluid-applied membrane weather barrier for a period of ten (10) years.
02 Warranty Areas: Warranty shall cover all vertical surfaces receiving the fluid-applied membrane weather barrier materials – field surfaces, joints flashings.
03 Coordinate with manufacturer for on-site observations and requirements for issuance of warranty.

B. Installation Warranty: Provide air barrier subcontractor's two (2) year warranty, including all components of the weather barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of Fluid Applied Weather Barrier is based on products manufactured by Henry Company.

B. The following manufacturers are acceptable for use for this Section, provided all specified requirements are met or exceeded.
01 Dupont
02 W.R. Meadows
03 Poly-Guard
04 Prosoco
05 Tremco

2.2 PRODUCTS

A. Design of Fluid Applied Weather Barrier is based on the following Henry Company products:
01 Henry Air-Bloc 17MR Fluid Applied, Vapor Permeable Air & Water Barrier Membrane.
02 Henry HE925 BES Sealant and Joint Treatment.
03 Henry Adhesives and Primers.
04 Henry Air-Bloc 21 Insulation Adhesive (refer to Section 07 21 00 – Thermal Insulation).
05 Henry Blueskin SA Flashing (refer to Section 07 65 26 – Self-Adhering Sheet Flashing).

06 Henry Blueskin TWF Thru-wall Flashing (refer to Section 07 65 26 – Self-Adhering Sheet Flashing).

B. Henry Air-Bloc 17MR Fluid Applied, Vapor Permeable Air & Water Barrier Membrane. One-component, water-based, elastomeric emulsion membrane, designed to provide a vapor permeable air and water barrier when applied above-grade wall assemblies, having the following properties:
01 Solids Content:
a. By Weight: 63%.
b. By Volume: 53%.
02 Service Temperature:
a. Low Temperature: -40°F (-40°C).
b. High Temperature: +180°F (+80°C).
03 Application Temperature:
a. Low Temperature: +20°F (-6°C).
b. High Temperature: +122°F (+50°C).
04 Tensile Strength (ASTM D412): 104 psi (717 kPa).
05 Elongation (ASTM D412): 420%.
06 Low Temperature Flexibility @ -22°F (-30°C) (ASTM D1970): Pass.
07 Freeze-Thaw Resistance (ASTM D2243): Pass; 10 cycles.
08 Nail Sealability (ASTM D1970): Pass.
09 VOC Content: 100 grams/liter max.
10 Water Absorption (ASTM D471, modified): 5.6%.
11 Water Vapor Permeance (ASTM E96 B) @ 40 mils nominal dry film: 14 perms.
12 Air Permeability:
a. Assembly Air Leakage (ASTM E2357): Pass.
b. Building Material (ASTM E2178): 0.0001 cfm/ft2 (0.0005 L/s.m2).
13 Chemical Resistance: Resists salt solutions, mild acids and alkalis. Non-resistant to oils, grease or solvents.
14 Fire Testing (NFPA 285): Complies in various assemblies.
15 Flame Spread/Smoke Development (ASTM E84): 10/15.
16 Resistance to Mold, Mildew, and Fungal Growth (ASTM D5590): No growth.

C. Design of building envelope and sheathing joint sealant is based on Henry HE925 BES Sealant: Moisture cure, medium modulus polymer modified sealing compound, having the following properties:
01 Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
02 Complies with ASTM C920, Type S, Grade NS, Class 35.
03 Elongation: 450 – 550%.
04 Remains flexible with aging.

D. Design of rigid insulation adhesive is based on Henry Air-Bloc 21 Insulation Adhesive: Synthetic trowel applied rubber-based adhesive having the following characteristics:
01 Compatibility: With air barrier membrane, substrate and insulation.
02 Air leakage: 0.0026 CFM/ft^2 @ 1.6 lbs./ft^2 to ASTM E283.
03 Water vapor permeance: 0.03 perms to ASTM E96.
04 Long term flexibility: CGSB 71-GP-24M.

E. Other materials and accessories as recommended by the manufacturer to provide an integrated, compatible weather barrier system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Substrate Conditions:
   01 Verify substrates to receive work and surrounding adjacent surfaces are in accordance with Air Barrier Manufacturer published literature prior to installation of fluid applied membrane air barrier assembly.
   02 Sheathing panels must be securely fastened and installed flush to ensure a continuous substrate in accordance with Air Barrier Manufacturer published literature.
   03 Fastener penetrations must be set flush with sheathing and fastened into solid backing.
   04 Mortar joints in concrete block and form tie holes/voids in poured concrete shall be filled, flush, smooth, and allowed to be cured for a minimum of twenty-four (24) hours.
   05 Cap and protect exposed back-up walls against wet weather conditions prior to application of fluid applied membrane air barrier assembly.

B. Notify Contractor in writing of any conditions that are not acceptable.

C. The installing Contractor shall examine and determine that surfaces and conditions are ready to accept the Work of this Section in accordance with published literature. Commencement of Work or any parts thereof shall mean installer acceptance of the substrate.

3.2 PREPARATION

A. All surfaces must be sound, dry to touch, clean, and free of oil, grease, dirt, excess mortar, frost, laitance, loose and flaking particles, or other contaminants.

B. Protect adjacent surfaces not included in scope of Work to prevent spillage and overspray.

C. Hot weather or direct-sun applications over porous substrates, such as concrete, promote rapid surface drying and can form blisters in the fluid applied membrane air barrier during curing. To aid in blister prevention prepare substrate in accordance with one of the following optional procedures:
   01 Prime coat:
      a. Apply a thin prime coat of fluid applied membrane air barrier to substrate.
      b. Allow fluid applied membrane air barrier to fully cure prior to subsequent application.
      c. Install primary fluid applied membrane air barrier to Air Barrier Manufacturer minimum recommended mil thickness.
   02 Two coat:
      a. Apply fluid applied membrane air barrier to achieve one-half (1/2) of Air Barrier Manufacturer minimum recommended mil thickness.
      b. Allow fluid applied membrane air barrier to fully cure prior to subsequent application.
      c. Apply fluid applied membrane air barrier to achieve one-half (1/2) of Air Barrier Manufacturer minimum recommended mil thickness.

d. Overall dry mil thickness shall be in accordance with Air Barrier Air Barrier Manufacturer published literature.

3.3 INSTALLATION

A. Ensure substrate is ready to receive fluid applied membrane air barrier in accordance with published literature.

B. If fluid applied membrane air barrier should freeze while in storage, move containers to a controlled environment above 32°F (0°C) until thawed and re-mix using a hand operated power mixer prior to use.

C. Fluid applied membrane air barrier shall not be applied when ambient (air) and substrate temperatures are below 20°F (-6°C).

D. Do not proceed with application of air barrier membrane when rain is expected within 16 hours.

E. Apply sealant at sharp corners, changes in substrate plane, penetrations, and edges to form a smooth transition from one plane to another.

F. Non-Moving Substrate Joint and Crack Treatment:
   01 Gaps at sheathing joints or openings through sheathing - equal to or less than 3/8 inch (10 mm) wide:
   02 Sheathing Joint Sealant:
      a. Apply sealant at rate recommended by Air Barrier Manufacturer.
      b. Spread sealant at joint extending a minimum one (1) inch beyond gap to ensure a continuous air and watertight assembly.
   03 For all gaps in excess of 3/8”, seal in strict accordance with manufacturer’s standards and recommendations for the specific condition.

G. Refer to Air Barrier Manufacturer Detail Drawings for installation procedures including, but not limited to, the following:
   01 Inside corners.
   02 Outside corners.
   03 Crack treatment.
   04 Penetrations.
   05 Rough openings.
   06 Control joints.
   07 Expansion joints.
   08 Changes in substrate.

H. Contact Air Barrier Manufacturer to coordinate transition of fluid applied membrane air barrier to adjacent areas including, but not limited to, the following:
   01 Roof to air barrier.
   02 Air barrier to waterproofing.
   03 Fastener penetrations.

I. Thru-Wall Flashing: Coordinate with Section 07 62 23 – Thru-Wall Flashing and Section 07 65 26 – Self-Adhering Sheet Flashing.

J. Primary Liquid Air Barrier Membrane:

01 Install fluid applied membrane air barrier in accordance with Air Barrier Manufacturer published literature to ensure an air and watertight fluid applied membrane air barrier assembly.
02 Fluid applied membrane air barrier assembly must be installed in a monolithic application without sags, runs or voids, and transitioning with auxiliary components to create a uniform drainage plane and air barrier.
03 Install fluid applied membrane air barrier and transition membranes so that subsequent membrane installation laps one (1) inch (2.5 cm) onto existing membrane ensuring an air and watertight fluid applied membrane air barrier assembly.
04 Fluid applied membrane air barrier total dry thickness shall be in accordance with Air Barrier Manufacturer published literature. Refer to Air Barrier Manufacturer Technical Data Sheet.

K. Insulation Adhesive: Coordinate with other trades as required.
01 Coordinate with Section 07 21 00 – Thermal Insulation for insulating materials.
02 Upon curing of the air barrier membrane system apply insulation adhesive in a serpentine pattern.
03 Immediately embed insulation into the adhesive and press firmly into place to ensure full contact. Apply additional adhesive if allowed to skin over.
04 Fully butter all joints of insulation panels with adhesive during installation, with the exception of expansion joints.

3.4 FIELD QUALITY CONTROL

A. Final Observation and Verification:
01 Prior to covering completed weather barrier work, final inspection of fluid applied membrane air barrier assembly shall be carried out by the Architect, the Contractor, and Air Barrier Manufacturer as required by warranty.
02 Contact Air Barrier Manufacturer for warranty issuance requirements.

B. Fluid applied membrane air barrier assembly is not designed for permanent UV exposure. Refer to Air Barrier Manufacturer published literature for product limitations.

3.5 CLEANING

A. Promptly as the Work proceeds, and upon completion, clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.

B. Clean soiled surfaces, spatters, and damage caused by Work of this Section.

C. Check area to ensure cleanliness and remove debris, equipment, and excess material from the site.

END OF SECTION

SECTION 07 41 13

METAL ROOF PANELS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 The work includes furnishing labor, materials and installation of pre-finished metal panel roofing, trim, flashing, and miscellaneous parts as indicated on Drawings and described herein.

C. Related Work:
   01 Section 05 41 00 – Structural Metal Stud Framing
   02 Section 06 10 00 – Rough Carpentry
   03 Section 07 21 00 – Thermal Insulation
   04 Section 07 42 13 – Metal Wall Panels
   05 Section 07 62 00 – Sheet Metal Flashing
   06 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: To be prepared by metal roof system manufacturer shall 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.
   01 Provide metal roof flashing, gutter and downspout Shop Drawings. Indicate gauge and finish of material, fastener type, finish and spacing, locations of field applied sealant, and location size and gauge of all back up plates.
   02 Roof Panel Attachment:
      a. Roof plan with wind uplift pressure calculations at field, corner and perimeter areas according to version of ASCE-7 referenced by locally-adopted Building Code and the authority having jurisdiction.
      b. Roof plan indication roof clip spacing pattern at field, corner, perimeters and where panels are to be fixed from thermal movement.

c. Roof panel attachment plan must be stamped by licensed engineer in State in which project is constructed, certifying roof attachment meets local Building Code requirements for wind uplift.

D. Engineering Calculations: Submit wind uplift pressure calculations according to ASCE 7 Wind Speed for project location with respect to appropriate Importance Factor, Exposure category and Safety Factor. Calculations shall be sealed by a Professional Engineer licensed to practice structural engineering in the state in which project is located.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

F. Samples:
01 Color charts or samples from the manufacturers standard line of Kynar 500 finishes for Architect's selection.
02 Sample of 12" long, full width coated panel showing metal gauge, seam and required finish.
03 Two samples of roof panel clip, clip fastener, bearing plate, and spacer block.

G. Submit sample warranties:
01 Coating Warranty.
02 Manufacturer Water Tightness Warranty complying with this Specification.
03 Installer Warranty.

H. Certification:
01 Submit roof panel manufacturer's certification that fasteners, clips, backup plates, closures, roof panels and finishes meet specification requirements, wind uplift requirements.
02 Submit roof panel manufacturer's certification that installer meets requirements to install roof system and is qualified to obtain required warranties.
03 Uplift Test Reports –Certified test results that indicate roof system meets or exceeds design and performance criteria. Testing to include:
a. Underwriters Laboratory: Submit documentation that panel System has been tested at Underwriters Laboratories per UL-580 and be currently listed under a UL Construction Number. Submit documentation that panel system has been tested in accordance with UL-580/1897 and has been tested to failure.
b. ASTM E 1592. Submit ASTM E 1592 Test reports prepared by independent test laboratory and stamped by a professional engineer substantiating that roof system will meet the allowable wind pressures with a safety factor of 2.0. Static Water Testing Certification:
c. The panel system shall be tested in accordance with FM4471 Appendix G, and pass with no leakage. The test specimen must successfully withstand being submerged under 6" of water for a minimum period of 7 days.

d. The panel system shall be tested in accordance with ASTM E2140- and pass with no leakage. The test specimen must successfully withstand being submerged under 6" of water for a minimum period of 6 hours.

04 Air and Water Testing Certification:
   a. ASTM E1680 – Manufacturer's test data for air infiltration rates up to 20 pounds per square inch differential pressure.
   b. ASTME1646- Manufacturer's test data for water infiltration rates up to 20 pounds per square inch differential pressure.

05 Impact Resistance: Submit documentation that panel system has been tested at Factory Mutual per FM 4471 Section 4.5 and is currently rated for "Severe Hail".

I. Operations and Maintenance Manuals:
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to Section 01 78 23 – Operations and Maintenance Manuals.
   03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

1.3 REFERENCES

A. ASTM International:
   01 ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   02 ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
   03 ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   04 ASTM D 1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.
   05 ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
   06 ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
   07 ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.
   08 ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   09 ASTM E 1514 - Standard Specification for Structural Standing Seam Steel Roof Panel Systems.
   10 ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
   11 ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
   12 ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
   13 ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

B. Factory Mutual: 4471 Approval Standard for Class 1 Panel Roofs:
   01 Section 4.1 Combustibility-From Below Roof Assembly.
   02 Section 4.2 Combustibility-From Above Roof Assembly.
   03 Section 4.3 Wind Uplift Resistance.

04 Section 4.4 Foot Traffic Resistance.
05 Section 4.5 Hail Damage Resistance.
06 Appendix G- Susceptibility to Leakage Test Procedure for Class 1 Panel Roofs.

C. SMACNA: Architectural Sheet Metal Manual, Latest Edition.

D. American Society of Civil Engineers (ASCE):
01 ASCE -7 - Minimum Design Loads for Buildings and Other Structures, version adopted by local Building Code authority having jurisdiction.

E. Building Code – as approved by local authority having jurisdiction.

1.4 DESIGN AND PERFORMANCE CRITERIA

A. Thermal Movement: Metal Roofing system, including flashing, shall accommodate unlimited thermal movement without buckling or excess stress on the structure.

B. Roof panel and trim attachments will be designed to satisfy the requirements of the roof design (shown in Shop Drawings).

C. Maximum wind uplift capacity of roof system shall be determined using certified results from UL 1897-98, Uplift Tests for Roof Covering Systems. Testing of the entire roof assembly shall be conducted in a UL-580 test chamber.

D. Panel system installation shall be in accordance with ASCE 7 Wind Speeds for project location with respect to appropriate Exposure category, Building Importance Factor and a Safety Factor of 2.0.

1.5 QUALITY ASSURANCE

A. Manufacturer: Manufacturer's facility and equipment must undergo an annual quality assurance audit by Factory Mutual. This assures that manufacturer's equipment, procedures and quality program are maintained to insure a uniform product consistent with that which was tested and FM Approved.

B. Installer of pre-formed metal roofing shall be experienced in the work and shall have no fewer than five (5) years of successful experience with installation metal roof systems similar to those required for this Project, and is qualified by the roof panel manufacturer, for installation of manufacturer-warranted systems.

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.

D. Install a 30-foot wide, quality control area of metal roofing, for review by the Architect, to establish the quality of installation for the roof, and have approved prior to installing additional metal panels.

1.6 COORDINATION

E. Coordinate Work, with installation of other associated Work, to ensure quality application.

F. Coordinate Work with installation of associated metal flashings and building walls.

G. Coordinate Work to minimize foot traffic and construction activity on installed finished surfaces.

H. Coordinate location of pipe penetrations to allow centering of pipe in panel.

I. Coordinate location of roof curbs, to allow proper integration with roof panel seams.

1.7 WARRANTY

A. Panel Coating: Furnish manufacturer's twenty (20) year panel coating warranty covering against becoming unserviceable or causing an objectionable appearance resulting from either defective or non- conforming materials and workmanship. Defects shall include but not be limited to the following:
   01 Leaking, checking, crazing, chalking, fading, and adhesion.
   02 Cracking, chipping or peeling of finish.
   03 Wrinkling, undue expansion, lifting, loosening, and splitting seams.

B. Provide manufacturer’s twenty (20) year durability warranty against rupture, structural failure and perforation due to corrosion, and against chalking, cracking and peeling.

C. Provide manufacturer's twenty (20) year No Dollar Limit warranty for weather-tightness. Weather-tightness warranty shall include labor and materials and shall apply to the roof system specified including related flashings, valleys, ridges, roof panels, roof penetrations, roof curbs, and trim.
   01 Warranties supplied by Metal Roof Installer or 3rd Party Warranties are not acceptable.

PART 2 - PRODUCTS

2.1 METAL ROOF PANELS

A. The design of metal roof panels is based on products manufactured by Nucor Building Systems.

B. Other acceptable manufacturers: The following manufacturers are acceptable to provide metal roofing panels, provided the proposed products meet or exceed all specified requirements.
   01 Atas International
   02 Berridge Manufacturing Co.
   03 Englert, Inc.
   04 Garland Company, Inc.
   05 Imetco
   06 MBCI
   07 McElroy Metal

C. Basis of Design: Nucor VR16II Vertical Rib Standing Seam Metal Roof Panels.
   01 Tested in accordance with ASTM E 1646 and E 1680 for water penetration and air infiltration, and per ASTM E1592 for wind uplift capacity.
   02 Panels shall be installed directly over roof purlins.

03 Panels to be installed on a flat substrate shall be factory formed.

D. Panel Substrate: Galvalume coated sheet steel, Type AZ-50, Grade 50 as described in ASTM A792; minimum 24 gauge.

E. General: A mechanically seamed pan-type standing seam roof panel with concealed clips.
01 Panels shall be field seamed, equal to Nucor Vise Lock 360 Seam.
02 Panels must be furnished and installed in continuous lengths from ridge to eave with no endlaps.
a. Panels too long to ship will be manufactured on site using manufacturer's employees and equipment.
03 Panels to be installed on a curved substrate shall be field formed in continuous lengths.

F. Physical Characteristics:
01 Gauge: Minimum 24; provide 22 gauge where required to meet wind load requirements.
02 Width: 16".
03 Seam Height: 2".

G. Panel Clips:
01 Clips: Floating type.
02 Clips used to attach panel to substrate shall provide minimum 3/8" air space between panel and roof deck to reduce heat transfer into the building envelope.
03 Provide manufacturer's standard profiles, gauge(s) and spacing as required to meet wind load requirements.

H. Characteristics:
01 All panels shall be symmetrical in design and shall be mechanically seamed with a field operated electric seaming machine provided by the manufacturer.
02 Seam cap matching panel finish with two rows of integral factory hot applied sealant.
03 Manufacturer watertightness warranty, meeting requirements of this Section.

I. Finish:
01 Ag Barn: Finish to be Galvalume with a clear coat acrylic finish.
02 Field House: Finish to be custom color to match West High School metal roof(s).

J. Fasteners and Accessories:
01 Concealed supports, angles, plates, accessories and brackets: in gauge and finish as recommended, and furnished by manufacturer.
02 Accessory Screw: Size and screw type as provided by panel manufacturer for each use, with prefinished hex washer head in color to match panels where exposed to view.
03 Rivets: full stainless steel, including mandrel, in size to match application.
04 Field Sealant: Color coordinated primerless silicone, or high grade, non-drying butyl, as supplied by panel manufacturer.
05 Sealant Tape: non-drying, 100 percent solids, high grade butyl tape, as supplied by panel manufacturer, in sizes to match application.

06 Pipe Penetration Flashings: flexible boot type, with stainless steel compression ring, and stainless-steel pipe strap, Dektite by Buildex, or approved substitute. Use silicone type at hot pipes.

07 Metal Roof Curbs: welded aluminum, or stainless steel, factory-insulated, with integral cricket, and designed to fit roof panel module, sized to meet application, by L.M. Curbs, or approved substitute.

2.2 RIGID INSULATION DECKING – FIELD HOUSE

A. The design of metal roof panels is based on products manufactured by Atlas Roofing Corporation.

B. Other acceptable manufacturers: The following manufacturers are acceptable to provide metal roofing panels, provided the proposed products meet or exceed all specified requirements.

01 Carlisle
02 Dow
03 GAF
04 IKO
05 Johns Manville
06 Rmax Operating
07 Soprema

C. Rigid Roof Insulation Board and Decking Board:

01 Provide and install roof insulation on the structural metal decking as required to achieve a smooth uniform roof with no bumps, crimps or unevenness. Must be compatible with the underlayment to be installed on it.

02 Install ASTM C-1289, Type II, Grade 3, Rigid Polyisocyanurate Roof Insulation; 2 layers of 2” thickness each for a total of 4" thickness. Stagger board joints.

a. RMax, Inc., Dallas, TX (LEED Regional Credit 5).
b. Atlas Roofing Corporation, Atlanta, GA.

03 Minimum R Value: 20 (R 10 each sheet).

a. Complies: ASTM C 578, Type IV.
b. Approvals: For installation in FM 4470 and I-90 Windstorm Classification.
c. Manufacturer: Dow Chemical.

D. Nailable Sheathing Deck:

01 Provide and install nailable plywood sheathing above rigid insulation board.

02 Nailable Plywood Sheathing: type CDX plywood, minimum 19/32” thickness.

03 Provide in 4’ x 8’ sheets.

04 Provide screw fasteners of sufficient length to penetrate metal deck substrate a minimum of 1”.

2.3 ROOFING UNDERLAYMENT – FIELD HOUSE

A. The design of roofing underlayment is based on products manufactured by W.R. Grace & Co.

B. Other acceptable manufacturers: The following manufacturers are acceptable to provide metal roofing panels, provided the proposed products meet or exceed all

specified requirements.

01 Atlas International
02 Carlisle
03 GAF
04 Henry Company
05 Soprema

C. Design of underlayment is based on Grace Ice & Water Shield HT.

D. General:

01 Self-adhering roofing underlayment comprised of an aggressive rubberized asphalt adhesive backed by a layer of slip resistant coated high density cross laminated polyethylene film.
02 Backed with release paper.
03 Membrane Thickness: Minimum 40 mils – ASTM D3767 method A.
04 Membrane Tensile Strength: 250 PSI – ASTM D412.
05 Membrane Elongation: 250% - ASTM D412.
06 Membrane Permeance: 0.05 Perms – ASTM E96.
07 Membrane Roll Width: 36”. Use maximum roll width wherever possible to eliminate joints.

PART 3 - EXECUTION

3.1 PREPARATION PRODUCT HANDLING, STORAGE AND DELIVERY

A. Immediately upon delivery to job site, place materials in area protected from weather. Materials shall be sorted and handled to prevent inclusion of foreign materials and damage by water or weather.

01 Exercise care in unloading, storing and erecting panels to prevent bending, warping, twisting and surface damage.
02 Storage: Store in original packages that are designed to protect against transportation damage, until ready for use. Store all material and accessories above ground on well skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between each panel.
03 Remove from site panels which are damaged, or become water-stained during storage and handling. Remove, and replace materials, which are installed damaged, or stained.
04 Do not permit unnecessary walking on finished roof. All personnel installing finished roof shall be required to wear rubber sole shoes.

B. Ensure surfaces are ready for panel application.

C. Inspect and ensure surfaces are free from objectionable warp, wave, and buckle before proceeding with installation of pre-formed metal roofing.

D. Ensure substrate is ready to receive metal roofing. Report items for correction and do not proceed with metal roof panel system installation until resolved.

3.2 INSTALLATION OF STANDING SEAM ROOFING

A. Comply with and install roofing and flashings in accordance with all details shown on manufacturer's approved Shop Drawings and manufacturer's product data and instructions, within specified erection tolerances.

B. Install field panels in continuous lengths, without endlaps. Remove and replace panels with endlaps.

C. Do not install panels damaged by shipment or handling.

D. Install intermittent clips with bearing plates and continuous clips according to pattern in wind uplift rating at field, corners, and perimeter roof areas.

E. Fix panels at location depicted on reviewed Shop Drawing(s).

F. Breadpan roof panel at ridge, hip, and headwalls.

G. Allow for 1-inch panel clearance at penetrations.

H. Install concealed supports, angles and brackets as furnished by manufacturer to form complete assemblies.

I. Remove roof panel and flashing protective film prior to extended exposure to sunlight, heat, and other weather elements.

J. Field-apply sealant tape and gun-grade sealant according to reviewed Shop Drawings and manufacturer's requirements for airtight, waterproof installation.

K. Ensure sealant beads and tape are applied prior to sheet metal installation to achieve a concealed bead. Neatly trim exposed portions of sealant without damaging roof panel or flashing finish.

L. Align pipe penetrations to occur at center of roof panel. Report and have corrected improperly placed penetrations before proceeding with panel installation. Remove and replace roof panels which have improperly placed penetration flashings.

M. Align roof curbs to fit roof panel module and overlap standing seam(s). Allow for proper drainage on both sides of curb.

N. Install sheet metal flashings according to manufacturer's recommendations, reviewed Shop Drawings and in accordance with provision of Section 07 62 00 – Sheet Metal Flashing.

3.3 WORKMANSHIP

A. Install panel systems straight and true, free from defects. Isolate dissimilar metal contact with proper taping and/or coatings. Install flashing and corners to provide a watertight system.

3.4 CLEANING

A. Clean exposed surfaces of Work promptly after completion of installation.

B. Clean mud, dirt, and construction-related debris from panels before panels are scratched or marred.

3.5 PROTECTION

A. Protect Work as required to ensure roofing will be without damage at time of final completion.

B. Do not allow excessive foot traffic over finished surfaces.

C. Do not track mud, dirt, or construction-related debris onto panel surfaces.

D. Replace damaged Work before final completion.

3.6 INSPECTION

A. Architect and Contractor reserve the right to inspect the Work during application.

B. Upon completion of the Work, if inspection discloses that roofing is not according to Specifications or has been damaged, Contractor agrees to furnish additional materials necessary to make repairs and place work in an acceptable condition.

END OF SECTION

SECTION 07 42 13

METAL WALL PANELS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 All exterior metal wall panels, soffits and associated flashing, sub-girts, sealants, and fasteners necessary and as indicated on the Drawings.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 05 41 00 – Structural Metal Stud Framing
   03 Section 07 21 00 – Thermal Insulation
   04 Section 07 41 13 – Metal Roof Panels
   05 Section 07 62 00 – Sheet Metal Flashing
   06 Section 07 92 00 – Joint Sealants
   07 Section 08 90 00 – Louvers and Vents
   08 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and

procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3” x 3”, but must be large enough to convey attributes of the proposed product.

G. Operations and Maintenance Manuals:
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to Section 01 78 23 – Operations and Maintenance Manuals.
   03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. ASTM International:
   01 ASTM A653/A653M Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   02 ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
   03 ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   04 ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
   05 ASTM E1680 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Metal Roof Systems Under Specified Pressure Differences Across the Specimen.
   06 ASTM E1646 Standard Test Method for Water Penetration of Metal Roof Systems by Uniform Static Air Pressure Difference.
   07 ASTM G90 Standard Practice for Performing Accelerated Outdoor Weathering of Non-Metallic Materials Using Concentrated Natural Sunlight.

B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Architectural Sheet Metal Manual.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: The manufacturer shall have had a minimum of ten (10) years of experience in the successful completion of projects employing similar materials, applications, and performance requirements.
B. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Architectural Sheet Metal Manual.

1.5 DELIVERY, STORAGE & HANDLING

A. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Identify fabricated components with UL 90 label where appropriate.

B. Packing, Shipping, Handling and Unloading:

01 Bundle panels in waterproof wrapping paper when nested, or wooden crates when panels cannot be nested.
02 Package trim and accessories in waterproof wrapping paper.

C. Storage and Protection: Store materials protected from exposure to harmful conditions. Store material in dry, above-ground location.
01 Stack prefinished material to prevent twisting, bending, abrasion, scratching and denting. Elevate one end of each skid to allow for moisture run off.
02 Store products of this section in manufacturer’s unopened packaging until installation of products.
03 Maintain dry, heated storage area for products of this section until installation of products.

1.6 WARRANTY

A. Paint Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish for twenty (20) years and in accordance with the paint supplier's standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of metal wall panels is based on Products manufactured by Nucor Building Systems.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
01 McElroy Metal Inc.
02 AEP Span
03 Berridge
04 MBCI
05 Pac-Clad

2.2 SYSTEM DESCRIPTION

A. Panel Performance Requirements: Provide panels, which have been manufactured, fabricated and installed to withstand structural and thermal movement, wind loading and weather exposure to maintain manufacturer’s performance criteria without defects, damage, failure or infiltration of water.

B. Air Infiltration: Maximum 0.011 CFM/LF of seam at static pressure of +/-6.24 PSF when tested per ASTM E1680.

C. Water Penetration: No uncontrolled water penetration through the panel joints at a static pressure of 12.0 PSF when tested in accordance with ASTM E1646.

D. Finish Performance Requirements:
01 Color Change and Fade Resistance: No cracking, peeling, blistering or loss of adhesion when tested in accordance with ASTM G23; color change, after removal of surface deposits such as dirt or chalk, maximum 5 Hunter units.
02 Humidity Resistance: No blistering, peeling or loss of adhesion, after 2000 hours testing in accordance with ASTM D2247.

2.3 WALL PANELS

A. Design of metal wall panels is based on Nucor Building Systems Nucor Classic Wall Nucor Accent Wall.

B. Nucor Classic™ Wall Panel: A through-fastened sidewall panel with 1 1/4” ribs at 12” on center. The area between the ribs is reinforced to minimize oil-canning.
   01 Gauge: 24.
   02 Dimensions: 36” wide by 1 1/4" high.
   03 Provide in continuous lengths from sill to eave.

C. Material: Galvalume Sheet Steel conforming to ASTM A792; AZ55 coating for bare; AZ50 coating for painted.
   01 Thickness: Minimum 24-gauge sheet thickness.

D. Panel Fasteners:
   01 All self-tapping sheet metal screws shall conform to A.S.A. Standard B 18.6 and shall have Type "A" or Type "AB" threads.
   02 Screws shall be equipped with metal and EPDM or neoprene washers.
   03 Optional self-drilling fasteners shall be No. 12-14 Type B self-drilling screw with non-walking point and two step thread to insure maximum strip-out torque in panel to panel usage.
   04 Screws and washers shall be carbon steel plated with .0003" thick zinc or cadmium.
   05 After plating, all exposed fasteners and washers shall be coated with one prime coat and two finish coats of baked silicone polyester. The color of the finish shall match the wall and/or roof panels.

2.4 TRIM AND ACCESSORIES

A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Metal flashing and trim components shall be manufacturer’s standard products and profiles as recommended by the manufacturer for the specific application.

C. Material: Galvalume Sheet Steel conforming to ASTM A792; AZ55 coating for bare; AZ50 coating for painted.
   01 Thickness: Minimum 26-gauge sheet thickness.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance.
   01 Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fascias, parapet caps, soffits, reveals, and fillers.

E. Gutters and Downspouts:
   01 Refer to section 07 62 00 – Sheet Metal Flashing

F. Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof manufacturer designed to withstand design loads.
   01 Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of

plastic factory-applied coatings.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

H. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

I. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
   01 Concealed Joint Sealants: Non-curing butyl, AAMA 809.2.
   02 Exposed Joint Sealants: Urethane, single component, ASTM C920.
   03 Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 MATERIAL FINISH

A. Finish:
   01 Galvalume with a clear coat acrylic finish.
   02 Provide a strippable, protective coating material on all finished portions of pre-finished flashing; to be removed following installation.

B. Finish for all wall and trim components shall be as selected by the Architect from manufacturer’s full range of standard color selections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
   01 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 wall panel manufacturer.
   02 Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
   03 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 systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   01 Shim or otherwise plumb substrates receiving metal panels.
   02 Flash and seal metal 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 panels are installed.
   03 Install screw fasteners in predrilled holes.
   04 Locate and space fastenings in uniform vertical and horizontal alignment.
   05 Install flashing and trim as metal panel work proceeds.
   06 Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   07 Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
   08 Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

C. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
   01 Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
   02 Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
   03 Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
   04 Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
   05 Flash and seal panels with weather closures at perimeter of all openings.

D. Retain "Watertight Installation" Paragraph below for hydrostatic (watertight) panel installation; delete for water-shedding panel installations.

E. Watertight Installation:
   01 Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
   02 Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   03 At panel splices, nest panels with minimum 4” end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual".
   01 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.
   02 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.

03 Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.

3.4 DAMAGED MATERIAL AND CLEANING

A. Damage caused by the manufacturer or Wall Panel Systems Contractor shall be repaired or replaced.

B. The General Contractor shall inspect and approve each completed wall area and be responsible for protecting finished work from damage by other trades.

C. The Wall Panel Systems Contractor shall remove all protective materials and labels from the wall components as they are installed.

D. The General Contractor shall be responsible for final cleaning of the wall panel system due to any conditions that occur after the Wall Panel Systems Contractor has completed an area. Cleaning is to be done in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all roofing system sheet metal flashing as indicated on the Drawings and required for a complete roofing system assembly.
   02 Include all shop and field formed stainless steel sheet metal work as shown on Drawings, specified or required, and required for a weathertight roofing assembly, including, but not limited to:
      a. Roof penetration sleeves, hood, and umbrella counterflashing, where required and not being provided by the metal roofing manufacturer.
      b. Metal counterflashing and thru-wall flashing.
      c. Gutters, downspouts, and splash pans.
      d. Trim and miscellaneous sheet metal flashing and accessories not exposed to normal ground view and not being supplied by the metal building systems or metal roofing manufacturers.
   03 Include all shop and field formed sheet metal work as shown on Drawings, specified or required, and required for a weathertight roofing assembly, including, but not limited to:
      a. Gutters, downspouts, and splash pans
      b. Trim and miscellaneous sheet metal flashing and accessories exposed to normal ground view. This provision shall typically include portions of stainless steel flashing that are near enough to a building edge / corner to become exposed to normal ground view.

C. All Work shall be coordinated with the specified roofing system in accordance with roofing system manufacturer's standards and requirements.
   01 Sheet metal flashing, when installed as a component of the roofing system, shall be included as a component of the roofing manufacturer's system warranty.
   02 Coordinate as required.

D. Related Work:
   01 Section 06 10 00 – Rough and Finished Carpentry
   02 Section 07 41 13 – Metal Roof Panels
   03 Section 07 65 26 - Self-Adhered Sheet Flashing
   04 Section 13 34 19 – Metal Building Systems
   05 All Sections of Work relating to or affecting the roof system, including mechanical, plumbing and electrical items. Verify and coordinate as required.

1.2 SUBMITTALS

A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
   01 Certifications: Documentation of wind uplift requirements for roof edge for specific project location.

C. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the work of this contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

G. Mock-Ups
   01 Provide full size mock-up of all shop built assemblies.
   02 Mock-ups shall be fabricated and finished using same materials proposed to be furnished.

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM):
   01 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

02 ASTM A666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
03 ASTM A240 / A240M - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
04 ASTM B32 – Standard Specification for Solder Metal.
05 ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
06 ASTM E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
07 ASTM E646 Standard Test Method for Tensile Strain-Hardening Exponents (n -Values) of Metallic Sheet Materials.

B. American Society of Civil Engineers (ASCE)
01 ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. National Association of Architectural Metal Manufacturers (NAAMM).

D. National Roofing Contractors Association (NRCA):
01 Roofing and Waterproofing Manual.

E. Sheet Metal and Air Conditioning Contractors National Associate, Inc. (SMACNA):
01 Architectural Sheet Metal Manual.

1.4 QUALITY ASSURANCE

A. Single source responsibility: Fabricator of roof-related flashing and accessories shall be from a single source supplier.

B. Sheet metal flashing that interfaces with the roofing system shall be installed by the roof installer. Coordinate as required for proper installation and interface in accordance with the roofing system manufacturer.

C. Comply with governing codes and regulation of authorities having jurisdiction.

1.5 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.

1.6 WARRANTY

A. Roofing Contractor's Warranty:
   01 Contractor shall warrant the sheet metal work and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight, for a period of five (5) years from date of Substantial Completion.
   02 Defects shall include, but not be limited to:
      a. Leaking water or bitumen within building or construction.
      b. Becoming loose from substrate.
      c. Loose or missing parts.
      d. Finish failure as defined above.

B. Manufacturer's Product Warranty:
   01 Manufacturer's standard twenty (20) year Kynar 500 Finish warranty signed by the manufacturer, guaranteeing covering failure of the fluoropolymer finish during the warranty period.
   02 Failure is defined to include, but not be limited to:
      a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
      b. Leaking water within building or construction.
   03 Correction may include repair or replacement of failed product.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers / fabricators providing sheetmetal flashing shall meet or exceed the following requirements:
   01 Their products meet or exceed all specified requirements.
   02 Company has a minimum of five (5) years of experience manufacturing products of the type specified.
   03 Products are approved for use by the roofing system manufacturer.
   04 Products have been tested in conjunction with roofing system as an assembly and as such has obtained the same approval and rating as the roofing membrane system.

B. Substitutions shall be in accordance with Division 1 requirements.

2.2 SHEET METAL MATERIALS

A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing system as an assembly and have the same approval and rating as the roofing system.

B. Stainless Steel:
   01 Conforming to ASTM A167 and A240/A240M.
   02 Type 302/304 Soft Temper.
   03 No. 2D finish.
   04 Minimum thickness 24 gauge, except as otherwise noted.

C. Prefinished Aluminum:
   01 Factory, precoated type aluminum conforming to Fed. Spec. QQ-A-250, ASTM B209.

D. Sheet Lead: Comply with FS QQ-L-201, Grade B.
   01 Four (4) pound minimum for use at roof drains and soil stacks.

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 for weather tight installation. (ZAC type).

C. Match finish of exposed heads with material being fastened.

D. Mechanical fasteners:
   01 Nails: ring-shank, minimum 1-1/2” in length with 1/2" diameter head.
   02 Washers: steel washers with bonded rubber sealing gasket.
   03 Screws: self-tapping sheet metal type of stainless steel or compatible with material being fastened, with integral EPDM washers.
   04 Rivets: stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.

E. Clips Cleats: Minimum .050 / 18 gauge aluminum or minimum 20 gauge stainless steel, as appropriate for associated material.
   01 At fascia, match material of fascia and provide one (1) gauge heavier (i.e. 18 to 16 gauge, 20 to 18 gauge)

2.4 RELATED MATERIALS

A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead, flux type and alloy composition as required and confirmed by the manufacturer for the metals to be soldered.

B. Flux:
   01 Phosphoric acid type, manufacturer’s standard.
   02 For use with stainless steel: acid-chloride type flux, except use rosin flux over tinned surfaces.
   03 For use with steel and copper: rosin flux.

C. Underlayment:
   01 At expansion joints: to be used as bellow; 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc. or Lexsuco.
   02 At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film.
   03 Provide compatible substrate primer as instructed by manufacturer.

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:
   01 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.
   02 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:
   01 Material: Stainless steel or extruded aluminum bar with lipped profile.
   02 Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4" x 3/8” oval holes spaced six (6) inches on center.
   03 Approved Product / Manufacturer: “TB 125” manufactured by TruFast Corp., or approved equal.

H. Splash Blocks:
   01 Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment.
   02 Use at locations where roof downspout drainage discharges on ground.

I. 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 FINISHES

A. Finish: Finish for all exposed to ground view sheetmetal work shall be a premium, factory applied / baked on PVDF paint finish using a Kynar 500 resin base, containing a minimum of 70% fluoropolymer, meeting AAMA 2605-98 standards.
   01 BASF “Fluoroceram”.
   02 PPG Industries “Duranar”.
   03 The Velspar Corporation “Fluopon”.
   04 Color on finish side shall match material on which sheet metal flashing is installed.
   05 Color on concealed side shall be manufacturer’s option.
   06 Provide a strippable, protective coating material on all finished portions of pre-finished flashing; to be removed following installation.

B. Finished Aluminum Sheetmetal Locations: Provide pre-finished aluminum sheetmetal at all flashing locations exposed to normal ground view(s), including continuation of component to non-exposed locations. Typical locations include, but are not limited to:
   01 Gutters, scuppers, collector heads and downspouts.

02 Masonry step flashing.
03 Fascias and associated trim.
04 Drip edges.
05 Finish of fasteners for all pre-finished aluminum sheetmetal shall match the finish of the associated component.

C. Stainless Steel Sheetmetal Locations: Provide stainless steel sheetmetal as described above at all flashing locations concealed from normal ground view(s). Typical locations include, but are not limited to:
01 Thru-wall flashing.
02 Counter flashing
03 Pitch pans.
04 Roof curbs / hoods and similar equipment flashing.
05 Roof-top equipment supports

2.6 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.
01 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.
01 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 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.

01 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:
01 Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
02 Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
03 Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

M. On Kynar 500 pre-finished metal, surface sand metal flanges prior to applying any primers.
01 Confirm requirements and prime all metal in contact with bituminous material.
02 Confirm requirements and prime all metal in contact with self-adhered sheet flashing.

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.

2.7 FABRICATED ITEMS

A. Metal Flashings:
01 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 3/4”.
02 Counterflashing: Minimum 24 gauge stainless steel, .040 aluminum prefinished (where visible from ground level), 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".
01 To be installed at all wall flashings and at curb flashing lengths longer than 5’-0”.

C. Roof Penetrations:
01 Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
02 Flashing Pans:
a. 24 gauge stainless steel.
b. Fabricate to provide installed minimum clear inside perimeter dimension of 2” on each side of penetrating element.
c. Fabricate pans to at least 6” above the finished roof membrane and with 1/4 inch hem at top edge and with 4” flanges.
d. Round all corners of flange.
03 Fabricate metal bonnets for all pans, no exceptions.

a. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached.
b. On beams and other steel, weld in place bonnets fabricated from 1/4" steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.

D. Continuous Cleats: Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.

E. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.

F. Angle Termination Bar: Aluminum pressure bar 1/8” x 1”.

G. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of 1”.

H. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
01 Formed in maximum twelve (12) foot lengths.
02 Match dimension of existing if not new construction. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
03 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.
04 Drip Edge with Factory Applied Flashing (TPO).
05 24 gauge galvanized steel with membrane manufacturer’s coating
06 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.
a. Install all anchoring devices as outlined in manufacturer literature.
07 Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
08 Gutter Straps and Supports: Minimum 3 .100 inch thick Downspout straps: Strap type, like metal, match color.
09 Downspout straps: Strap type, like metal, match color.
10 Gutter Screen: .050” Aluminum with ¼” dia. perforations
11 Collector Heads: As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.
12 Downspout protection: Install 2” wide, 45 degree, “V” strap (hemmed to strengthen strap) secured over the opening of the downspout and pop riveted to insert.
13 Rake edge: Rake edge to extend a minimum of 2” into the gutter.
14 Color: Bronze anodized

I. Downspout Boots:
01 Approved products: Cast Aluminum by Barry Pattern & Foundary; Style B25A or Cast Iron by Neenah Foundry Company, Series R-4929 or pre-approved equal.
02 Provide downspouts boots in size and configuration as shown on drawings or as required for pipe sizes and downspout sizes. Minimum 36” length.
03 Separate dissimilar metal, where applicable.

04 Connection to underground storm drain pipe shall be accomplished with a female threaded PVC/SDR fitting. Flexible Fernco or equal type fittings are NOT allowed.
05 Color to match downspout.

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.
01 Exposed edges of sheet metal shall be folded back to form 1/4” hem on concealed side from view.
02 Finished work shall be free from water retention and leakage under all weather conditions.
03 Pre-fabricated corners or transitions are required at changes in direction, elevation, or place and at intersections.
04 Locate field joints not less than 12” nor more than 3’ from actual corner.
05 Laps shall be 1”, riveted and soldered at following locations:
a. Pre-fabricated corners.
b. Transitions.
c. Changes in direction, elevation, and plan.
d. At intersections.

B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling.
01 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 instruction and recommendations and with SMACNA Architectural Sheet Metal Manual.

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 locations of contact as recommended by manufacturer of fabricator.
   01 Do not use materials which are incompatible with roofing system.

E. Counterflashing:
   01 Do not use surface mount counterflashing.
   02 Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
   03 Coordinate installation of through wall flashing with the Masonry Contractor.
   04 Seal through wall in conjunction with masonry wall waterproofing.
   05 Install wind clips 30” on center at all counterflashing over 5’ in length.

F. Sanitary Vent Stacks:
   01 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.
   02 Fold lead sleeve down inside of pipe a minimum of 1”. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.

G. Gutters / Downspouts:
   01 Install gutters as detailed.
   02 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.
   03 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 phosphitized 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 26

SELF-ADHERING SHEET FLASHING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide self-adhering sheet flashing at exterior walls where indicated on drawings and as required to provide a continuous, sealed building envelope.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 05 41 00 – Structural Metal Stud Framing
   01 Section 06 10 00 – Rough and Finish Carpentry
   02 Section 07 41 13 – Metal Roof Panels
   03 Section 07 42 13 – Metal Wall Panels
   04 Section 07 62 00 – Sheet Metal Flashing
   05 Section 09 21 16 – Gypsum Board Assemblies
   06 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the work of this contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

D. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

E. Sample Panel: Sample panel shall be 8' long x 6' high panel showing completed through-wall flashing at first course of masonry and dampproofing assembly, complete with exterior sheathing, rigid insulation (where applicable). Coordinate as required with other trades.
   01 Panel shall be “L” shaped (4’ x 4’) with metal stud / drywall back-up wall on one side and CMU back-up on one side.
   02 Once accepted by the Architect, the sample panel shall be the standard by which installed is judged.
   03 Sample panel shall remain at the jobsite until all through-wall flashing and dampproofing is completed.

F. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 WARRANTY

A. Provide a material and labor, non-prorated, manufacturer / installer minimum two (2) year warranty that material will remain free of defects and installation shall remain water tight.
   01 Defects shall include, but not be limited to delamination, slippage on substrate and / or deterioration of sheet.

PART 2 - PRODUCTS

2.1 SELF ADHERING SHEET FLASHING MANUFACTURERS

A. Design of self-adhering sheet flashing is based on products manufactured by Henry Company.

B. Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this Section, provided proposed products meet or exceed all specified requirements:
   01 Grace Construction Products
   02 Polyguard Products, Inc.
   03 Tremco

C. Provide primers, glass fabric scrim tape, mastic and other materials not specifically described, as required for a complete and proper installation as recommended by the manufacturer.

2.2 SELF ADHERING SHEET FLASHING

A. By definition for Work covered by this Section, “self-adhering sheet flashing” shall refer to all flexible flashing installed at both through-wall and non-through-wall conditions.
   01 Metallic thru-wall flashing shall be as specified in Section 07 62 00 – Sheet Metal Flashing.

B. Flexible, Self-Sealing Wall Flashing:
   01 Design of self-adhering sheet flashing is based on Henry Company Blueskin WP200 Self-Adhered Waterproofing.
   02 Description: Self-adhering, membrane consisting of an SBS rubberized asphalt compound which is integrally laminated to a cross laminated polyethylene (HDPE) film, specifically designed for self-adhering to a

prepared substrate, and provides a high-performance waterproofing barrier.

03 Width: 36-inch wide rolls.

04 Thickness: 60 mils

05 Elongation: 300% minimum (ASTM D412 Die C).

06 Water vapor transmission: 0.02 perms (ASTM E96 Method B).

07 Membrane tensile strength: 325 psi minimum.

C. Primers and Sealants:

01 Provide primers as recommended by the manufacturer for the specific substrate, condition and assembly.

02 Provide sealants as recommended by the manufacturer for the specific substrate, condition and assembly.

D. Termination Bar: Provide where indicated on the Drawings.

01 1” x 1/8” aluminum or stainless steel flat bar.

02 Pre-drilled to fasten at maximum 16” O.C.

03 Fasteners shall be cadmium plated or stainless steel, self-tapping screws.

PART 3 - EXECUTION

3.1 PREPARATION

A. Working Conditions: Apply under normal working conditions above 45°F and rising. Do not apply when rain is imminent.

B. Storage: Keep container tightly sealed and protect from freezing in shipping and storage.

C. Surface Preparation:

01 All dust, dirt, old loose or scaling coatings shall be removed from the surface before coating or application of thru-wall flashing.

02 All brick ledge conditions shall be free of dirt and dust prior to application of thru-wall flashing.

03 All cracks, joints, penetrations, and splits should be sealed, repaired with 4 inch wide glass fabric scrim tape embedded in Henry Company #789.

04 Dusty or porous masonry surfaces should be dampened with water. Highly porous masonry should be primed with Henry Company #788 Asphalt Primer or #351 Non-fibered Emulsions which has been thinned with 1 gallon water per 5 gallons of #788.

05 Metal surfaces shall be free of rust, cleaned and primed.

06 Architect shall approve the taping of joints and surface preparation prior to the application of the dampproofing.

3.2 LOCATIONS

A. Self-Adhering Sheet Flashing:

01 All foundation masonry / brick ledges. At locations where adjacent concrete flatwork is above the bottom of the brick ledge, two (2) layers shall be applied – one at base of brick ledge and one at the first brick course above the adjacent flatwork.

02 Over heads of openings on steel lintel angles back to wall sheathing / substrate.

03 Under sills and at jambs of openings (not thru wall). Install additional thru-wall flashing at window jambs to lap over the end dams of all sub-

sill flashing. Coordinate with window installer as required.

04 At perimeter of building at roof lines and parapets (not thru wall) extending down onto exterior walls (sheathing or CMU as applicable).

05 At all exterior wall conditions as required to divert moisture within wall cavities to the building exterior.

06 At all openings through exterior sheathing / CMU resulting from structural steel or other interfacing work.

07 Bridging building expansion joints that telegraph into exterior back-up wall substrate.

08 Where indicated on Drawings.

B. Termination Bar: Continuous at the top edge of the vertical surface of all thru-wall flashing at all masonry ledges, wall-to-roof masonry conditions and masonry lintels.

C. The completed installation of thru-wall flashing shall render the building water tight except at door and window openings.

3.3 INSTALLATION – SELF-ADHERING SHEET FLASHING

A. Install all self-adhering sheet flashing and dampproofing in strict accordance with the manufacturer's specifications and recommendations.

01 Take all necessary precautions to eliminate fish-mouths and other irregularities. Where they occur, cut out and apply additional layer(s) of thru-wall flashing as required to achieve a smooth surface.

02 Carefully construct corner assemblies and vertical transitions / steps to assure proper lapping of adjacent sheets to provide positive drainage. Lap joints shall be a minimum of 4 inches.

03 All thru-wall flashing shall be installed prior to application of dampproofing.

B. Do not extend self-adhering sheet flashing at masonry / brick ledges and lintels to face of masonry. Cut back 1/2" to 3/4" from exterior face.

C. Carefully coordinate with the Masonry Contractor to install thru-wall flashing at the proper brick course(s). Thru-wall flashing shall form a continuous barrier at all transitions.

3.4 TESTING AND INSPECTING

A. Not more than ten (10) days after completion of this portion of the Work, at the discretion of the Architect, demonstrate by running water test that the Work of this Section will successfully repel water.

01 Notify the Architect at least 48 hours in advance, and conduct the test in the Architect's presence.

02 By means of an outrigger, or similar acceptable equipment, place the nozzle of a 3/4 inch garden hose at a point approximately 10'-0" away from top of wall where approved by the Architect, aiming the nozzle at slight downward angle to direct full stream of water onto wall.

03 Run water onto wall at full available force for not less than four hours.

04 Upon completion of the four-hour period, inspect interior surfaces of wall for evidence of moisture penetration.

B. If evidence of moisture penetration is discovered, apply an additional coat of dampproofing to the exterior surface in areas directed by the Architect. Repeat

application and testing at no additional cost to the Owner, until no evidence of moisture penetration is found.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 This Section includes exterior building and site work sealants.
   02 Sealants for moving joints.
   03 Interior caulking.
   04 Provide foam backer rods where shown or required for proper installation of sealants.

C. Related Work:
   01 Section 08 80 00 – Glazing
   02 Section 32 13 13 – Concrete Paving and Flatwork

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
   01 If products from an acceptable manufacturer are being submitted, specifically cross reference the proposed products to the listed as the basis of design products.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.

01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.

G. On-site sample for Architect's approval of colors.

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. ASTM International:
01 ASTM C510 – Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
02 ASTM C661 – Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
03 ASTM C719 – Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
04 ASTM C794 – Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
05 ASTM C834 – Specification for Latex Sealants.
06 ASTM C920 – Specification for Elastomeric Joint Sealants.
07 ASTM C1087 – Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
08 ASTM C1193 – Guide for Use of Joint Sealants.
09 ASTM C1247 – Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
10 ASTM C1248 – Test Method for Staining of Porous Substrate by Joint Sealants.
11 ASTM C1311 – Specification for Solvent Release Sealants.
12 ASTM C1330 – Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
13 ASTM D412 – Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
14 ASTM D624 – Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
15 ASTM D2203 – Standard Test Method for Staining from Sealants.
16 ASTM D2240 – Test Method for Rubber Property - Durometer Hardness.

B. NSF International:
01 NSF Standard 51 – Food Equipment Materials.

C. U.S. Food and Drug Administration (FDA):
01 21 CFR 177.2600 - Title 21 Part 177 Indirect Food Additives: Polymers

1.4 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 or workmanship.

B. Warrant exterior joints against failure of the joint to effectively seal out water or moisture. Warrant interior joints against cracking, crazing separation of the material from the substrate or other joint failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design is based on products manufactured by Tremco.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
   01 Dow Chemical Co.
   02 Pecora, Inc.
   03 Sonneborn
   04 Manufacturers of products bearing the Thiokol Corporation seal of approval. All polysulfide sealants shall bear the seal.

2.2 MATERIALS

A. Caulking for exposed non-working interior locations at all hollow metal frames and abutting surfaces at ceiling, wall angles and all other locations for finished appearance:
   01 Type: Tremco “THC-901”.
   02 A multi-component, polyurethane sealant providing a fast-setting pliable seal with minimal shrinkage.

B. Exterior concrete horizontal joints, including drives, parking, sidewalks, play surfaces and other flatwork:
   01 Type: Tremco Vulkem 45SSL.
   02 High performance multi-component, chemically curing polyurethane sealant.

C. Exterior highly active joints in walls, masonry or concrete fences:
   01 Type: Tremco Dymeric.
   02 Gun grade, general purpose multi-component, chemically curing polyurethane sealant.

D. Exterior joints around windows, glazing, entrances, soffit joints and other general sealant areas:
   01 Tremco Spectrem 2.
   02 Medium-modulus, one-part, high performance, neutral-cure silicone sealant.

E. Exterior joints of concrete tilt-wall panels.
   01 Tremco Dymonic 100.

02 High performance, medium-modulus, low VOC, UV-stable, non-sagging polyurethane sealant.

F. Interior Expansion Contraction or Control Joints where movement is to be accommodated: Tremco “Mono”.
01 Tremco Spectrem 2.
02 Medium-modulus, one-part, high performance, neutral-cure silicone sealant.

G. Interior General Purpose:
01 Tremco Tremflex 834.
02 High performance, one-part acrylic latex sealant.

H. Primers, Cleaners, Top Coats: Use only materials listed as suitable in resistance to staining, compatibility and durability before proceeding.

I. Back-Up Filler: Closed cell or open cell, non-gassing filler as recommended by sealant manufacturer.

J. Sealant colors shall be as selected by the Architect from manufacturer’s full range of color selections.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine all assemblies to receive sealant and verify all Work is complete as required for the proper installation of sealant.

B. Do not accept joints that are wider than joint width limitations of the sealant to be used.

C. Notify Contractor of any irregularities and / or discrepancies and do not proceed until fully resolved.

3.2 APPLICATION

A. Temperatures: Do not install sealants when air temperature is under 40°F. Sealants may be warmed to ease installation when recommended by the manufacturer.

B. Tooling:
01 Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer.
02 The tooling procedure shall press sealant against the sides of the groove.
03 No materials shall be left "feathered" out or smeared on the abutting materials.
04 If necessary, protect adjacent surfaces with tape.
05 Completed joints shall have a uniform professional appearance.
06 Use an anti-tack compound on sealant that does not set up fast enough to avoid dust collection.

C. Sealant Back-Up: Provide a 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 one and one-half times the compressed width. Lap ends a minimum of 2 inches.

E. Seal ends together in such a manner to allow natural drainage.
   01 Install filler by compressing material and sliding into joint.
   02 Align filler on one face of the joint before it expands to the full joint width.

3.3 CLEAN-UP

A. Immediately following installation of sealants, remove all excess sealant as required to result in clean sealant lines and applications.

B. Protect sealant installations as required until sealant has reached final set.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all interior and exterior hollow metal frames, including interior glazed opening frames, where indicated or scheduled on the Drawings.
   02 Provide all interior and exterior hollow metal doors where indicated or scheduled on the Drawings.

C. Related Work:
   01 Section 01 22 00 – Unit Prices
   02 Section 04 20 00 – Unit Masonry
   03 Section 07 92 00 – Joint Sealants
   04 Section 08 71 00 – Door Hardware
   05 Section 08 80 00 - Glazing
   06 Section 09 21 16 – Gypsum Board Assemblies
   07 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
   01 Show or schedule location, size, thickness, elevation, details of construction, location and extent of hardware blocking, fire rating and other pertinent data for each door required.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. If project is within a TWIA wind zone, provide documentation demonstrating compliance and inclusion in TDI approved door and frame assemblies.
   01 For all exterior hollow metal framing, provide documentation in the form of a Texas Engineer signed and sealed certification that proposed door and frame assembly, including proposed anchoring and hardware, meets or exceeds specified wind loads.

E. Finish Hardware Location: Hollow metal manufacturer shall obtain an approved hardware schedule, hardware templates and samples of physical hardware where necessary to ensure correct fitting and installation.

F. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

G. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

1.3 REFERENCES

A. ASTM International (ASTM):
   01 A240/A240M-15b - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   02 ASTM A366 - Steel, carbon, cold-rolled sheet, commercial quality.
   03 ASTM A526 - Steel sheet, zinc-coated (galvanized) by hot dip process, commercial quality.
   04 A653/A653M-15 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip.
   05 A1008/A1008M-15 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
   06 B209-14 - Aluminum and Aluminum-Alloy Sheet and Plate.
   07 B209M-14 - Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
   08 B221-14 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   09 B221M-13 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
   10 D3656/D3656M-13 - Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns.
   11 E90-09 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

B. National Association of Architectural Metal Manufacturers (NAAMM), AMP 500-06 - Metal Finishes Manual.

C. National Fire Protection Association (NFPA), NFPA 80-16 - Fire Doors and Other Opening Protectives.

D. UL LLC (UL):
   01 10C-09 - Positive Pressure Fire Tests of Door Assemblies.
   02 1784-15 - Air Leakage Tests of Door Assemblies and Other Opening Protectives.

E. American National Standards Institute:
   01 ANSI A151-1-1969, Test Method for Standard Steel Doors.
   02 ANSI A250.11-2001 Recommended Erection Instructions for Steel Frames.

1.4 DELIVERY AND HANDLING

A. Deliver, store and handle hollow metal work in strict accordance with manufacture's recommendations to prevent damage, rust and deterioration.

B. Store materials in a covered, dry location and promptly clean and touch-up scratches or rust spots with a rust-inhibitive primer.

C. Doors shall have their wrappings or coverings removed upon delivery at the building site and shall be stored in a vertical position spaced by locking for air circulation.

D. Doors and frames shall be clearly identified with opening number as indicated on the Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hollow metal door and frame manufacturers shall be members of the National Association of Architectural Metal Manufacturers (NAAMM).

B. The following manufacturers are acceptable to provide hollow metal doors and frames subject to meeting all provisions and requirements of this Section of Specifications:
   01 American Door Products
   02 Ceco / United Dominion Industries
   03 Curries
   04 Door Pro Systems
   05 Pearland Industries
   06 Republic Doors and Frames
   07 Steelcraft

2.2 MATERIALS

A. Doors:
   01 Doors shall be custom made, of types and sizes shown on reviewed Shop Drawings, and shall be fully welded seamless construction with no visible seams or joints on faces or vertical edges.
   02 Minimum door thickness shall be 1 3/4 inches, unless specifically noted or shown differently.
   03 Doors shall be strong, rigid and neat in appearance, free from warp and buckle. Corner bends shall be true and straight and of minimum radius for gauge of metal used.
   04 Provide 22-gauge steel stiffeners spaced max. 6-inch O.C. and extending full height of door.
   05 Fill interior with foamed in place urethane. Use mineral filler as required for labeled doors.
   06 Door Face Gauges:
      a. Doors 36" wide or less shall be 16 gauge galvanized.

b. Doors 37” wide or more shall be 14 gauge galvanized.

07 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.

08 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 welded to both faces.

a. Exterior doors shall have an additional flush closing channel at top and bottom edges.

b. Openings shall be provided in the bottom closure channel at top and bottom edges.

c. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.

09 Edge profile shall be provided on both vertical edges of door as follows:

a. Single-acting swing doors - beveled 1/8 inch in 2-inch.

10 Hardware Reinforcements:

a. Doors shall be mortised, reinforced, drilled and tapped at factory for fully templated hardware, in accord with the reviewed hardware schedule and template provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.

b. Minimum gauges for hardware reinforcing plates shall be as follows:

1. Hinge & pivot reinforcements: 7 gauge.
2. Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
3. Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
4. Channel / U-reinforcing at door lights shall be minimum 20 gauge; continuous all sides.

11 Edge Clearances:

a. Between door and frame at head and jambs: 1/8 inch.

b. At door sills with no threshold, 5/8 to 3/4 inch above finished floor.

c. At door sills with threshold, as required to suit threshold.

d. Between meeting edges of double doors - 1/8 inch.

12 Door Lite Kits: Design is based on Curries Type 9 Window Molding; 20 gauge, galvannealed material; wrap-around configuration, secured with vandal-proof fasteners.

13 Door Louvers: Fabricate from minimum 20 gauge and galvannealed material; inverted “Y” blade, sight-proof type, unless otherwise shown. Louver frame shall be wrap-around type secured with vandal-proof fasteners.

B. Frames:

01 Frames for exterior openings shall be made of commercial cold rolled steel conforming to ASTM A366, and shall be galvanized after fabrication.

02 Frames for interior openings shall be a) commercial grade, cold-rolled steel conforming to ASTM A366 or b) commercial grade hot rolled and pickled steel conforming to ASTM A569.

03 Door Frame Gauges:

a. Exterior opening frames 48” wide or less shall be 14 gauge.

b. Exterior opening frames 49” wide or more shall be 12 gauge.
c. Interior opening frames 48” wide or less shall be 16 gauge.
d. Interior opening frames 49” wide or more shall be 14 gauge.

04 Window Frame Gauges:
a. Interior opening frames with jamb / vertical mullions width / spacing 72” wide or less, and 30 SF or less shall be 16 gauge.
b. Interior opening frames with jamb / vertical mullions width / spacing 73” wide or more, and greater than 30 SF shall be 14 gauge.

05 Frames shall be custom made, welded units with integral trim of sizes and shapes shown on Drawings and required for the specific intended use.
a. Door stops shall be nominal 5/8”.
b. Returns shall be 1/2".

06 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.

07 Jamb depths and profile shall be as shown on Drawings and required for the specific intended use.

08 Corner joints shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted.

09 Minimum depth of stops shall be 5/8 inch.

10 Frames for multiple openings shall have mullion and rail members which are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth.

11 Hardware Reinforcements: Frames shall be mortised, reinforced, drilled and tapped at factory for fully templated hardware in accordance with finish hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.

12 Minimum thickness of hardware reinforcing plates shall be as follows:
a. Hinge and pivot reinforcements (1-1/4" x 10" minimum size): 7 gauge.
b. Strike reinforcements: 12 gauge.
c. Flush bolt reinforcements: 12 gauge.
d. Closer reinforcements: 12 gauge.
e. Reinforcements for surface-mounted hardware, hold-open arms, surface panic devices: 12 gauge.

13 Floor anchors shall be securely welded inside each jamb, with holes for floor anchorage.

14 Jamb Anchors for 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:
a. Frames up to 7'-6" height - 3 anchors.
b. Frames 7'-6" to 8'-0" height - 4 anchors.
c. Frames over 8'-0" height - 1 anchor for each 2 feet, or fraction thereof in height.

15 Jamb Anchors for 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:

a. Frames up to 7'-6" height - 4 anchors.
b. Frames 7'-6" to 8'-0" height - 5 anchors.
c. Frames over 8'-0" height - Four anchors plus one additional for each 2 feet, or fraction thereof over 8’-0”.

16 Jamb Anchors for frames to be anchored to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design as shown on reviewed shop drawings.

17 Dust cover boxes of not less than 26-gauge steel shall be provided at all mortised hardware items.

18 Frames shall be provided with steel spreader temporarily attached to bottoms of both jambs for bracing during shipping and handling.

19 Glass stops for interior glazed frames shall be loose stops, not less than 18-gauge steel, 1/2" x 1/2", with butt corner joints, secured to frame opening by countersunk tamper proof screws. Snap-on attachments will not be acceptable.

20 Prepare frame for silencers. Provide three single silencers for single doors on strike side. Provide two single silencers on frame head at double doors without mullions.

C. Finish: Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:

01 Clean surfaces free of mill scale, rust, oil, grease, dirt and other foreign matter.

02 Chemically treat surfaces and apply one coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.

03 Frames at exterior openings shall be coated on the inside of the frame with a commercial grade, water-based mastic compound (or other approved coating material) prior to installation; 20 mil minimum coating / coverage.

D. Labeled Doors and Frames:

01 Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled. Such doors and frames shall be constructed as tested and approved by Underwriters Laboratories or other nationally recognized testing agency having a factory inspection service.

02 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Separate dissimilar metals, protect against galvanic action.

B. Frames:

01 Anchorage and Connections: Firmly anchor and secure to adjacent construction in strict accordance with manufacturer’s Shop Drawings and installation instructions.

02 Frame Spreader Bars: Leave intact until frames are set permanently square and plumb and frame anchors are securely attached.

03 Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed.

04 Installation of labeled frames shall conform to National Fire Protection Association Pamphlet No. 80, “Fire Door and Windows” and UL design requirements.

05 At exterior locations, coat interior of frame with mastic or other approved coating material prior to installation; minimum 20 mil thickness.

C. Doors:

01 Hang doors square, plumb and straight, firmly anchored into position. Eliminate hinge bound conditions and making all items smooth operating. Adjust operable parts for correct functions.

02 Apply hardware in accordance with hardware manufacturer’s templates and instructions.

03 Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed.

04 Installation of labeled doors shall conform to National Fire Protection Association Pamphlet No. 80, “Fire Doors and Windows” and UL design requirements.

D. Coordinate with other trades as required for installation of glass and glazing to be installed in doors and frames.

E. Immediately after erection, sand smooth all rusted and damaged areas of prime coat and apply touch-up with compatible air-drying primer.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Access flush access doors where indicated on the Drawings.
   02 Access flush access doors at all plumbing chases. Coordinate locations with Architect.
   03 Provide flush access doors in horizontal gyp board and / or plaster ceilings or soffits as indicated on the Drawings.
   04 Where access doors are installed in a rated partition or assembly, provide fire-rated access doors.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 09 21 16 – Gypsum Board Assemblies
   03 Divisions 22 and 23 – Access doors for plumbing and mechanical items.
   04 Division 26 – Access doors for electrical items

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies. Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of access doors is based on products manufactured by Milcor, Inc.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed all specified requirements.
   01 Acudor Products Inc.
   02 The Bilco Company
   03 Ruskin Company

2.2 MATERIALS

A. Design of access doors is based on Milcor:
   01 Series M Architectural Access Door for non-fire-rated assemblies.
   02 Series UFR Universal Fire Rated Access Door for rated assemblies.

2.3 ACCESS DOORS – NON-FIRE-RATED

A. Design of non-fire-rated access doors is based on Milcor Series M Architectural Access Door.

B. Door: 16-gauge, cold rolled steel.

C. Frame: 16 gauge. cold rolled steel. Frame to be provided with pre-formed mounting holes 3/16“ diameter at 4” spacing. Inner frame included to allow latching.
   01 Provide cadmium plated or stainless-steel screws as appropriate for wall substrate.

D. Hinge: Concealed spring hinges open to 175 degrees for complete access without allowing the door to impact the wall. Quantity varies per door panel size. Extracting pin from hinge leaf attached to panel permits panel removal.

E. Latch: Cylinder lock (replaces one cam latch) furnished with two keys. Additional custom options available upon request.

F. Finish: Powder coat colors - Grey, Gold Sand, Jet Black as selected by the Architect.

G. Sizes: Unless otherwise indicated on the Drawings, provide the following:
   01 Single User Restrooms: 18” x 18”.
   02 Multi User Restrooms: 22” x 30”.
   03 Gypsum Board Ceilings: 24” x 24”.
   04 Plaster Ceilings and Soffits: 24” x 24”.

2.4 ACCESS DOORS – FIRE-RATED

A. Design of non-fire-rated access doors is based on Milcor Series UFR Universal Fire Rated Access Door.

B. Door: 20-gauge, cold rolled steel sandwich panel with 2” mineral fiber insulation.

C. Frame: 16 gauge 4-piece cold rolled steel with masonry anchors.

D. Hinge: 18-gauge continuous piano hinge with stainless steel pin.

E. Closer: Coil spring self-closing.

F. Latch: Self-latching paddle latch and locking system with key-operated cylinder lock furnished with two keys and interior release mechanism; (1) per door for sizes below 36”; (2) per door for sizes 36” - 48”.

G. Rating:
   01 Rating is maintained for a two-hour wall.
   02 Carries UL and CUL 1½ -hour, Class B fire rating.
   03 Warnock Hersey Label for three-hour noncombustible ceiling systems.
   04 UL Certified: 250°F temperature rise protection for cold rolled steel; 450°F temperature rise protection for stainless steel.

H. Finish: Powder coat colors - Grey, Gold Sand, Jet Black as selected by the Architect.

I. Sizes: Unless otherwise indicated on the Drawings, provide the following:
   01 Single User Restrooms: 18” x 18”.
   02 Multi User Restrooms: 22” x 30”.
   03 Gypsum Board Ceilings: 24” x 24”.
   04 Plaster Ceilings and Soffits: 24” x 24”.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate locations with the trade that is constructing the material being penetrated.

B. Verify by comparing packing slip and box label that product is per Specification.

C. Verify that the substrate is dry, clean, and free of foreign matter and in compliance with requirements for installation tolerances and other conditions affecting performance. Report and correct any defects prior to any installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Refer to manufacturer’s product literature for surface preparation requirements.
   01 Surfaces should be structurally sound, free of voids, spalls, loose aggregate and sharp ridges. Remove dust, dirt, debris or any other foreign materials.

3.2 INSTALLATION

A. Install access doors in strict accordance with manufacturer's instructions and approved submittals.

B. Take all necessary precautions to protect adjacent work and finishes. Coordinate with other trades to repair finishes and other damaged during installation.

C. Test units for proper function and adjust until proper operation is achieved.

D. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

A. Remove and replace access doors with damage, bowing, or warping that interferes with the installation or functionality of product.

B. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

C. Protect completed work from subsequent construction activities as recommended by manufacturer.

END OF SECTION

SECTION 08 33 13

COILING COUNTER DOORS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide non-fire-rated overhead coiling counter doors where indicated or scheduled on the Drawings.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 05 50 00 – Metal Fabrications
   03 Section 06 10 00 – Rough Carpentry
   04 Section 08 33 23 – Overhead Coiling Doors
   05 Section 09 21 16 – Gypsum Board Assemblies

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:

01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.

G. Operations and Maintenance Manuals:
01 Provide complete operations and maintenance manuals to the Owner.
02 Refer to section 01 78 23 – Operations and Maintenance Manuals
03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. ASTM International (ASTM):
01 ASTM A480/A480M – Standard Specification for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
02 ASTM A653/A653M – Standard Specification for Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
03 ASTM A666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
04 ASTM B209 – Standard Specification for Aluminum - Alloy Sheet and Plate.
05 ASTM B221 – Standard Specification for Aluminum - Alloy Extruded Bars, Rods, Wires, Shapes and Tubes.

B. National Fire Protection Association (NFPA) - 80 – Standard for Fire Doors and Fire Windows.

C. Underwriters Laboratories (UL) 10B - Standard for Fire Tests of Door Assemblies.

1.4 QUALITY ASSURANCE

A. Company specializing in the manufacturing of products specified in this Section and with a minimum of five (5) years of experience.

B. Installer Qualifications: Installer shall be authorized and qualified to install overhead door systems on the type and scope of project specified.

C. Source Limitations: Provide overhead coiling doors from one manufacturer for each type of door. Provide operators and other accessories from source acceptable to overhead coiling door manufacturer.

D. Performance Requirements:
01 Fire Door Construction: Conform to UL 10B
02 Installed Fire Door Assembly: Conform to NFPA 80

1.5 WARRANTY

A. Standard Warranty: Two (2) years from date of shipment against defects in material and workmanship.

B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design is based on coiling counter door products provided by Cornell Cookson

B. Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this Section, provided proposed products meet or exceed all specified requirements.
   01 C.H.I. Overhead Doors
   02 North American Door Corporation
   03 Overhead Door Co.

2.2 MATERIALS

A. Stainless Steel Sheet:
   01 ASTM A480/A480M or ASTM A666 – Type 304 or 316, roll form temper.

B. Aluminum:
   01 Extrusions: ASTM B221, alloy and temper best suited to application.
   02 Sheet: ASTM B209, alloy and temper best suited to application.

2.3 OVERHEAD COILING COUNTER DOOR – NON-FIRE-RATED – EXTERIOR

A. Design of coiling counter door is based on CornellCookson, model ESC 10 manual rolling counter door
   01 Curtain:
      a. Galvanized Steel with Finish as Described Below: No. 1F, interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, minimum 22 gauge ASTM A 653, Commercial Quality, galvanized steel with extruded tubular aluminum bottom bar with continuous lift handle and vinyl astragal
   02 Finish:
      a. GalvaNex **-**ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and baked-on polyester enamel finish coat
      b. Color as selected by Architect from manufacturer's full range of color selections.
   03 Endlocks; Fabricate interlocking slat sections with high-strength, molded nylon endlocks riveted to ends of alternate slats.
   04 Guides:
      a. Stainless Steel: 12 gauge formed shapes
      b. Finish: type 304 #4 finish
   05 Shaft Assembly:
      a. Counterbalance Shaft Assembly:
         1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width
         2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25

lbs (110 N). Provide wheel for applying and adjusting spring torque

06 Brackets:
- a. Fabricate from reinforced steel plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures
- b. Finish**:** Hot-dip Galvanized: ASTM A 123, Grade 85 zinc coating, hot-dip galvanized

07 Hood:
- a. Exterior: Minimum 22-gauge galvanized steel with reinforced top and bottom edges. Provide minimum ¼ inch steel intermediate support brackets.
- b. Finish:
  1. GalvaNex **-** ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding baked-on base coat and baked-on polyester enamel finish coat
  2. Color as selected by Architect from manufacturer's full range of color selections.

08 Mount: Face of wall

09 Operation: Manual
- a. Push up: Provide hand crank operator

10 Locking: Rollup doors and keyed switches must have a standard keyed lock and box that is keyed to the building master key system (Schlage Primus for exterior doors and Schlage for interior doors).

11 Exterior Wind Loading: Supply doors to withstand up to 30 PSF minimum design wind load.

12 Size(s): As noted on drawings

PART 3 - EXECUTION

3.1 PREPARATION

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 only after all unsatisfactory conditions have been corrected.

D. Coordinate with Electrical and Fire Alarm Contractors as required for proper rough-in and final connections required for a fully functional assembly.

3.2 INSTALLATION

A. Install in strict accordance with manufacturer's printed instructions and recommendations at locations shown on Drawings.

B. Anchor to adjacent construction without distortion or stress.

C. Fit and align door and shutter assembly including hardware, plumb, level and square to ensure smooth operation.

D. Adjust hardware and moving parts so that doors operate smoothly throughout full operating range.

E. Adjust seals to provide a tight fit around the entire perimeter.

F. No cords or wires shall be exposed and/or within reach of students.

3.3 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.4 DEMONSTRATION

A. Prior to Owner demonstration, submit and receive approval of operation and maintenance manuals required in Section 01 77 00 – Close-Out Procedures. Provide O&M manuals to Owner prior to conducting Owner demonstration.

B. Demonstrate proper operation to Owner's Representative.

C. Instruct Owner's Representative in maintenance procedures.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide overheard coiling doors in sizes and locations as indicated on the Drawings.
   02 Assemblies shall be complete, including guides, hoods, operator, weather seals and accessories.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 08 11 13 – Hollow Metal Doors and Frames
   03 Section 08 71 00 – Door Hardware
   04 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide engineering and calculations demonstrating compliance with wind load and other requirements.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey the finish attributes of the proposed product.

G. Operations and Maintenance Manuals:
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to section 01 78 23 – Operations and Maintenance Manuals
   03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. ASTM International:
   01 ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   02 ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   03 ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   04 ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
   05 ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

B. American National Standards Institute (ANSI):
   01 ANSI / DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

C. National Electrical Manufacturers Association (NEMA):
   01 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   02 NEMA MG 1 - Motors and Generators.

1.4 SYSTEM DESCRIPTION

A. Design Requirements:
   01 Wind Loading: Refer to Section 01 11 23 – Code Summary.

02 Cycle Life: Design doors of standard construction for normal use of up to 20 cycle per day maximum.
03 Insulated Door Slat Material Requirements:
a. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84.
b. Minimum Sound Transmission Class (STC) rating of 26 as tested per ASTM E90.
c. Minimum R-value of 8.0 (U-factor of 0.125) as calculated using the ASHRAE Handbook of Fundamentals.
d. Insulation to be CFC Free with an Ozone Depletion Potential (ODP) rating of zero.

1.5 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 or workmanship.

B. Defects shall include, but not be limited to the following:
01 Rough or difficult operation.
02 Noisy operation.
03 Loose or missing parts.
04 Noticeable deterioration of finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of overhead coiling doors is based on products manufactured by Cornell Cookson.

B. The following manufacturers are acceptable provided proposed products meet or exceed performance and attributes of basis of design, and specified requirements:
01 C.H.I. Overhead Doors
02 North American Door Corporation
03 Overhead Door Co.

2.2 MATERIALS

A. Design of overhead coiling doors is based on Cornell Iron Works Model ESD10 Coiling Overhead Door.

B. Curtain:
01 Slat Material: No. 6F, (Listed Exterior/Interior):
a. Galvanized Steel/Galvanized Steel: 24 gauge, Grade 40, ASTM A653 galvanized steel zinc coating.
b. Slats have a Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84.
02 Slat Finish: GalvaNex™ Coating System and phosphate treatment followed by baked-on polyester powder coat.
a. Minimum 2.5 mils cured film thickness; ASTM D3363 pencil hardness: H or better.
b. Color as selected by Architect from manufacturer's full range of color selections.

03 Bottom Bar: Reinforced extruded aluminum 6063-T5; minimum 3-3/8” height; minimum 3/16” base thickness; minimum 4” wide.

04 End Locks: Alternate slats each secured with two ¼” (6.35 mm) rivets. Fabricate interlocking sections with high strength nylon. Provide windlocks as required to meet specified wind load.

C. Guides:

01 Fabricate with minimum 3/16” structural steel angles.

02 Provide windlock bars of same material when windlocks are required to meet specified wind load.

03 Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides.

04 Provide removable guide stoppers to prevent over travel of curtain and bottom bar.

05 Top 16 ½" (419.10 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service.

06 Finish: Steel: ASTM A123, Grade 85, zinc coating, hot-dip galvanized after fabrication.

D. Counterbalance Shaft Assembly:

01 Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.

02 Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.

E. Brackets: Fabricate from minimum 3/16 inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.

01 Finish: ASTM A123, Grade 85 zinc coating, hot-dip galvanized after fabrication.

F. Hood: 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.

01 Finish: GalvaNex™ Coating System and phosphate treatment followed by baked-on polyester powder coat, color as selected by Architect from manufacturer's standard color range, flat black.

G. Weatherstripping:

01 Bottom Bar: Replaceable, bulb-style, compressible EDPM gasket extending into guides.

02 Guides: Replaceable vinyl strip on guides sealing against fascia side of curtain.

03 Lintel Seal: Nylon brush seal fitted at door header to impede air flow.

04 Hood: Neoprene/rayon baffle to impede air flow above coil.

H. Locks:

01 Rollup doors and keyed switches must have a standard keyed lock and box that is keyed to the building master key system (Schlage Primus for exterior doors and Schlage for interior doors).

2.3 OPERATORS

A. Operation - Manual Chain Hoist:
   01 Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide.
   02 Chain hoist to include integral brake mechanism that will immediately stop upward or downward travel and maintain the door in a stationary position when the hand chain is released by the user.

B. Accessories: Provide all accessories required for a complete, operable assembly in accordance with manufacturer's standards and recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

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 only after all unsatisfactory conditions have been corrected.

D. Coordinate with Electrical Contractor as required for proper rough-in and final connections required for a fully functional assembly.

3.2 INSTALLATION

A. Install in strict accordance with manufacturer's printed instructions and recommendations at locations shown on Drawings.

B. Anchor to adjacent construction without distortion or stress.

C. Fit and align door and shutter assembly including hardware, plumb, level and square to ensure smooth operation.

D. Adjust hardware and moving parts so that doors operate smoothly throughout full operating range.

E. Adjust seals to provide a tight fit around the entire perimeter.

F. No cords or wires shall be exposed and/or within reach of students.

3.3 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.4 DEMONSTRATION

A. Prior to Owner demonstration, submit and receive approval of operation and maintenance manuals required in Section 01 77 00 – Close-Out Procedures. Provide O&M manuals to Owner prior to conducting Owner demonstration.

B. Demonstrate proper operation to Owner's Representative.

C. Instruct Owner's Representative in maintenance procedures.

END OF SECTION

SECTION 08 80 00

GLAZING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Exterior glass
   02 Glazing of hollow metal doors.

C. Related Work:
   01 Section 06 10 00 – Rough and Finish Carpentry
   02 Section 08 11 13 – Hollow Metal Doors and Frames
   03 Section 08 71 00 – Door Hardware

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Design Calculations: Provide engineering calculations, signed and sealed by a Texas Registered Structural Engineer, which demonstrate the design, assemblies and anchoring of proposed glazing assemblies meet or exceed the stated wind load requirements for all conditions.

G. Samples: Show manufacturer's full range of colors:
   01 Samples of each type of glass (12" x 12" minimum).
   02 In place sample of sealant at frame perimeter for Architect's approval. Architect shall select samples for review from manufacturer's full color line.
   03 Obtain hardware templates from finish hardware supplier.
   04 Samples of framing finish for approval and fastener types.
   05 Sample of proposed sub-sill flashing; minimum 12" in length, complete with end dams on both ends.

H. Mock-up:
   01 In conjunction with mock-up wall required for masonry and back-up walls, provide a mock-up window incorporated into the masonry mock-up.
   02 Mock-up window shall be minimum 16" x 16" and shall include head, jamb, sill framing members and sub-sill flashing. Glass is not required.
   03 Construct in such a way that all fastening methods are viewable.
   04 Perimeter of window shall be sealed continuous.

I. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. American National Standards Institute (ANSI):
   01 ANSI Z97.1 – American National Standard for Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.

B. American Society for Testing and Materials (ASTM):
   01 ASTM C162 – Standard Terminology for Glass and Glass Products.
   02 ASTM E 774 – Standard Specification for Sealed Insulating Glass Units.
   03 ASTM C920 Standard Specification for Elastomeric Joint Sealants.
   04 ASTM C1036 – Standard Specifications for Flat Glass.
   05 ASTM C1048 – Standard Specification for Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass.
   06 ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
   07 ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Door
   08 ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
   09 ASTM E1300 - Standard Practice for Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load.
   10 ASTM E2010-01 – Standard Test Methods for Positive Pressure Fire Tests for Window Assemblies.
   11 ASTM E2188 – Standard Test Method for Insulating Glass Unit Performance.

12 ASTM E2189 - Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units.
13 ASTM E2190 – Standard Specification for Insulating Glass Unit Performance and Evaluation.

C. American Architectural Manufacturers Association (AAMA)
01 AAMA 502 – Specification for Field Testing of Newly Installed Fenestration Products.
02 AAMA 503 – Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.

D. Federal Specifications:
01 Fed. Spec. DD-G-001403 B.
02 Fed. Spec. TT-S-00230 Sealing Compound: Synthetic Rubber Base and TT-S-00203C.
03 Fed. Spec. TT-S-001657 Sealing Compound: Butyl Rubber Base.
04 Fed. Spec. DD-G-451d.

E. National Fire Protection Association (NFPA):
01 NFPA 80 – Fire Doors and Windows.
02 NFPA 252 – Fire Tests of Door Assemblies.
03 NFPA 257 – Fire Tests of Window Assemblies.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, comply with pertinent recommendations contained in:
01 Flat Glass Marketing Association:
a. Glazing Sealing Systems Manual.
b. Glazing Manual.

C. Fire Protective Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire protective assemblies.

D. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E2074-00, classified and labeled by UL acceptable to authorities having jurisdiction.

E. Field Testing:
01 Water penetration and air infiltration field testing shall be performed by the Materials & Testing Laboratory or by a third-party building envelope testing consultant under separate contract with the Owner.
02 Testing of three (3) different locations shall be performed at the following intervals of the glazing installation: 10% complete, 50% complete and 90% complete.
03 Specific test locations shall be determined on the day of the testing; and may include both first and second floor locations.
04 Refer to Part 3 – Execution for additional information.

F. Manufacturer's Field Representation:
   01 The manufacturer shall provide on-site observation by a qualified technical representative familiar with the window systems being installed at the following times:
      a. Commencement of Window Installation: Representative shall observe the complete installation of the first window being installed.
      b. Field Testing: Representative shall be present for all field testing of windows and glazing.
      c. Periodic site observation visits during window / glazing installation at the following intervals of installation completeness: 25%, 50%, 75% and 100%.
   02 Within seventy-two (72) hours after each site observation visit, the manufacturer's representative shall furnish an observation report documenting activities, direction to the installer, and other pertinent information.

1.5 WARRANTY

A. Submit a written warranty, executed by the entrance manufacturer, agreeing to repair or replace units that fail in workmanship for a period of five (5) years from date of Substantial Completion. Failures include, but are not limited to:
   01 Structural and performance failures, including excessive deflection, excessive leakage, air infiltration beyond specified requirements.
   02 Faulty operation of hardware directly related to items listed above.
   03 Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Glass: The following manufacturers are acceptable to provide glass products in accordance with the specified requirements:
   01 Vitro (Formerly PPG Industries) Basis of Design
   02 AGC Flat Glass North America, Inc. (formerly AFG Industries)
   03 HGP Industries, L.L.C.
   04 Oldcastle Building Envelope
   05 TGP Architectural

2.2 PERFORMANCE SPECIFICATIONS

A. Requirements apply simultaneously through the most adverse conditions of each exterior application.
   01 Thermal Movement at Exterior Systems: Provide for noiseless expansion and contraction of all materials and assemblies due to temperature changes in a range between 10°F and 180°F, without detriment to appearance or performance.
   02 Water Infiltration at Exterior Systems: Drain water entering at joints and condensation occurring within the wall construction to the exterior face of the wall. Allow no uncontrolled water other than condensation on the interior face of the wall.
   03 Air Filtration at Exterior Locations: Limit air leakage to maximum 0.005 CFM/SF at 6.24 PSF.

2.3 GENERAL MATERIALS

A. Glazing Materials at Hollow Metal Frames:
   01 General: Use glazing compound and preformed glazing sealants approved for the application, except as otherwise specified, conforming to Glazing Materials portion of the FGMA Glazing Manual.
   02 Sealant:
      a. One part acrylic polymer sealant conforming to Federal Spec. TT-S-00230 or silicone, Federal Spec. TT-S-0023-C. Use for glazing of all fixed glass. Include primer as recommended by manufacturer.
      b. Color: Shall as selected by Architect from manufacturer's full range.
      c. All sealants shall be compatible with adjacent material per manufacturer's recommendations and instructions.
   03 Setting Blocks: Hard rubber or clean grain softwood.
   04 Back-up Material: Foamed polyethylene or polystyrene rod stock; sizes as required by joint condition, and compatible with sealant.
   05 Glazing Tape: DAP #1202 or as approved.
   06 Glazing Gaskets: Extruded neoprene, free of porosity, surface defects, dimensional irregularities, and conforming to physical properties of ASTM C502.
   07 Use of metal sash putty will not be permitted, but compound conforming to Federal Spec. T-G-410 will be permitted. The use of non-skinning compounds, non-resilient type preformed sealers and preformed impregnated type gaskets will not be permitted.

2.4 GLASS MATERIALS

A. Glass Type G-4: Insulated Glass:
   01 Overall thickness of 1" comprised of 2 lites of 1/4" glass separated by a 1/2" air space.
   02 Air space to be dual sealed and meeting the certification requirements of the IGCC for a CBA rating.
   03 Exterior / Outboard Lite shall be:
      a. Fully Tempered Tinted Glass.
      b. Complying with ASTM C1048, Type I, Class 2 (tinted), Quality 3, Kind FT.
      c. Tinting shall match other adjacent TISD school projects on larger site. Solarban 67(2) Optigray
   04 Interior / Inboard Lite shall be:
      a. Fully tempered glass.
      b. Complying with ASTM C1048, Type 1, Class 1 (clear), Quality 3, Kind FT.
      c. Clear.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Thoroughly examine conditions at each and every location under which Work of this Section will be performed.

B. Clean glazing channels, stops, and rabbets to receive the glazing materials, making free from obstructions and deleterious substances which might impair the work.
   01 Remove protective coatings which fail in adhesion or interfere with bond of sealants.
   02 Comply with manufacturer's' instructions for final wiping of surfaces immediately prior to application of primer and glazing compounds or tapes.
   03 Prime surfaces to receive glazing compounds in accordance with manufacturer's recommendations.

3.2 INSTALLATION – GLASS

A. Inspect each piece of glass immediately prior to start of installation.
   01 Do not install items which are improperly sized, have damaged edges, are scratched, abraded, or damaged in any other manner.
   02 Do not remove labels from glass until so directed by the Architect.
   03 Install glass so distortion waves, if present, run in a horizontal direction.

B. Locate setting blocks at sills one quarter of the width of the glass in from each end of the glass, unless otherwise recommended by the glass manufacturer.
   01 Use blocks of proper size to support the glass in accordance with the manufacturer's recommendations.
   02 Provide spacers for all glass sizes larger than 50 united inches, to separate glass from stops, except where continuous glazing gaskets or felts are provided.
      a. Locate spacers no more than 24 inches apart, and no closer than 12 inches to a corner.
      b. Place spacers opposite one another.
      c. Make bite of spacer on glass 1/4 inch or more.

C. Set glass in a manner which produces the greatest possible degree of uniformity in appearance.

D. Do not use two different glazing materials in the same joint system, unless the joint use is approved in advance by the Architect.

E. Mask, or otherwise protect surfaces adjacent to installation or sealants.

F. Install all glass, gasket and aluminum framing in strict accordance with manufacturer's printed instructions.

G. Caulk joints continuous at exterior and interior faces of framing and elsewhere as indicated, as required to meet performance specifications using materials specified in Section 07 92 00 – Joint Sealants. Follow sealant manufacturer's printed instructions for the installation of his product.

3.3 FIELD TESTING

A. Field Tests: Architect shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured.
   01 Interior finishes at window recess (i.e. gypsum board, window sill) shall not be installed at window units to be tested.

02 If interior finishes at window recess have been installed at windows to be tested, they shall be removed by Contractor prior to testing; and then reinstalled at no additional cost to the Owner.

B. Manufacturer's representative shall be present to observe all field tests and retests.

C. Testing:
01 Testing shall be performed per AAMA 503 by a qualified independent testing agency.
02 Air Infiltration Tests: Conduct tests in accordance with ASTM E 783.
a. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.
03 Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105.
a. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 PSF.

D. Failed Tests:
01 Tests not meeting specified performance requirements and units having deficiencies shall be corrected by the Contractor and the failed window unit / area shall be retested.
02 In addition to retesting the failed window unit / area, an additional two (2) similar window units / areas shall be tested.
03 All retesting and testing caused by a failed test shall be at the expense of the Contractor.

3.4 PROTECTION

A. Protect glass from breakage after installation by promptly installing streamers or ribbons, suitably attached to the framing and held free from glass.
01 Do not apply warning markings, streamers, ribbons, or other items directly to the glass, except as specifically directed by the Architect.

B. Protect all window framing during and after installation from marring, blemishes, scratches and damage due to incidental adjacent work.
01 If damaged, make all necessary repairs or replacements in accordance with the manufacturer's recommendations and as directed by the Architect.

END OF SECTION

SECTION 08 90 00

LOUVERS AND VENTS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide louvers and vents in exterior walls as indicated on the Drawings.
   02 Provide louvers and vents in interior walls as indicated on the Drawings.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 07 25 00 – Weather Barrier
   03 Section 07 42 13 – Metal Wall Panels
   04 Section 07 65 26 – Self-Adhering Sheet Flashing
   05 Section 09 21 16 – Gypsum Board Assemblies
   06 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.

03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. American Architectural Manufacturer’s Association (AAMA):
   01 AAMA 605.2 - High Performance Organic Coatings on Architectural Extrusions and Panels.

B. Air Movement and Control Association (AMCA):
   01 AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
   02 AMCA 511 - Certified Ratings Program for Air Control Devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of louvers and vents is based on products Ruskin.

B. Acceptable Manufacturers: the following manufacturers are acceptable to provide products of this Section provided proposed products meet or exceed all specified requirements:
   01 Airstream Products
   02 All-Lite
   03 Construction Specialties, Inc.

2.2 MATERIALS

A. Design of exterior louvers is based on Ruskin Model HZ700 extreme performance louver.
   01 Louver Materials and Fabrication:
      a. Performance Ratings: AMCA 550 listed.
      b. Size(s): As indicated on the Drawings.
      c. Frame:
         1. Material: Extruded aluminum, Alloy 6063-T6.
         2. Wall Thickness: 0.080 inch (2.0 mm), nominal.
         3. Frame Depth:
            a) Front Frame: 4 inches
            b) Back Frame: 3 inches
   02 Blades:
      a. Style: Horizontal front blade on 3.8” center to center spacing and rear blade on a 3/4" center to center spacing.
      b. Material: Extruded aluminum, Alloy 6063-T6.
      c. Wall Thickness:
         1. Front blade: 0.080 inch (2.0 mm), nominal.
         2. Rear Blade: 0.050 inch (1.3 mm), nominal.
   03 Finish:
      a. Kynar 500
      b. Color to be selected by the Architect from the full range of standard colors.
   04 Bird Screen:
      a. Material: 5/8” x 0.040” expanded, flattened aluminum.
      b. Frame: Removable, rewritable.

   05 Performance Data:

a. Based on testing 48-inch x 48-inch size unit in accordance with AMCA 500.
b. Free Area: 53 percent, nominal.
c. Free Area Size: 8.49 square feet.
d. Maximum Pressure Drop at 1,000 fpm: 0.3 inches W.G.
e. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/m2) of free area at an air flow of 803 feet per minute free area velocity when tested for 15 minutes.

06 Wind Driven Water Penetration Performance:
a. Based on testing 39 inches x 39 inches (1 m x 1 m) core area, 41 inches x 44 inches (1.04 m x 1.12 m) nominal size unit in accordance with AMCA 500-L.
b. Wind Velocity: 29 mph (47 kph).
1. Rainfall Rate: 3 inches/hour (76 mm/hour).
2. Free Area Velocity: 1562 feet per minute (7.9 m/s).
3. Water Resistance Effectiveness: 99.8% (AMCA Class A).
c. Wind Velocity: 50 mph (80 kph).
1. Rainfall Rate: 8 inches/hour (203 mm/hour).
2. Free Area Velocity: 1558 feet per minute (7.9 m/s).
3. Water Resistance Effectiveness: 99.8% (AMCA Class A).

07 Design Load: Incorporate structural supports required to withstand wind load of +/-130 PSF.

08 Sub-Sill Flashing:
a. All louvers shall be furnished with continuous sub-sill flashing, spanning the full width of the rough opening.
b. Sub-sill flashing shall be minimum 0.065” aluminum with integral (turned up) end dams and back dams. Minimum height of dams shall be 1”.
c. Open vertical joint at end dam/back dam junction shall be TIG welded continuously to form a seamless dam component, directing any / all trapped water to the outside of the building.
d. Finish of sub-sill flashing shall match louver finish.
e. Provide a 1” glazing frame at louvers located in window wall systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with Contractor and other trades as required for rough opening and blocking requirements for proper installation of louver and vent assemblies.

B. Confirm rough opening size and preparation are correct prior to start of installation.

3.2 INSTALLATION

A. Install work of this Section in strict accordance with manufacturer's printed instructions and final accepted submittals.

B. Louver sub-sill flashing shall be set in a full bed of sealant.

C. Coordinate to have all sides of louver and vents sealed continuous to adjacent materials.

D. For operable louvers and vents, completely test all functions to confirm all mechanical elements of the assembly are functioning correctly.

E. Provide continuous sealant at perimeter of frame after installation.

END OF SECTION

SECTION 09 21 13

PLASTER ASSEMBLIES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Exterior cement plaster.

C. Related Work:
   01 Section 09 91 00 - Painting and Re-Painting

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide elevations indicating layout of all proposed plaster joints.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.
   04 Upon selection of plaster finishes / colors by Architect, provide two (2) 12”x12” samples of each selected finish / color.

1.3 QUALITY ASSURANCE

A. ASTM International:
   01 A653/A653M-13 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   02 A1064/A1064M-14 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   03 C11-13 - Terminology Relating to Gypsum and Related Building Materials and Systems.
   04 ASTM C35 76 - Inorganic Aggregates for Use in Gypsum Plaster Type II.
   05 C91/C91M-12 - Masonry Cement.
   06 C150/C150M-12 - Portland Cement.
   07 C206-14 - Finishing Hydrated Lime.
   08 C207-06 - Hydrated Lime for Masonry Purposes.
   09 C260/C260M-10a - Air Entraining Admixtures for Concrete.
   10 C847-14a - Metal Lath.
   11 C897-05 - Aggregate for Job-Mixed Portland Cement Based Plasters.
   12 C926-14a - Application of Portland Cement-Based Plaster.
   13 C932-06 - Surface-Applied Bonding Compounds for Exterior Plastering.
   14 C933-14 - Welded Wire Lath.
   15 C979/C979M-10 Pigments for Integrally Colored Concrete.
   16 C1002-14 - Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
   17 C1063-14d - Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
   18 E90-09 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   19 E119-14 - Test Methods for Fire Tests of Building Construction and Materials.
   20 E413-10 - Classification for Rating Sound Insulation.

B. Federal Specifications: Fed. Spec. SS-L-00351a, Type F.

C. Metal Lath Manufacturer's Association.

D. American Subcontractor's Association: ASA No. A42.4.

E. Texas Lathing and Plastering Contractor Association / Texas Bureau for Lath and Plaster.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are acceptable provided proposed products meet or exceed all specified requirements.

B. Portland / Masonry Plaster:
   01 Holcim
   02 National Gypsum Co.
   03 TEIFS / ParexUSA
   04 TXI

C. Lath & Metal:
   01 Alabama Metal Industries Corp. (Amico).
   02 Bailey Metal Products Limited
   03 Bostwick Steel Lath Co.
   04 Dietrich
   05 Fry Reglet
   06 Marino Industries
   07 United States Gypsum Co.
   08 Western Metal Lath Co.

D. Acrylic Finish Coat:
   01 Dryvit
   02 Finestone
   03 R-Wall
   04 Senergy
   05 STO

2.2 MATERIALS

A. Cement Plaster:
   01 Portland cement: comply with ASTM C-150, Type I.
   02 Sand: provide sand that meets ASTM C-144 (Sharp Torpedo Type) finish coat graded per ASTM C842.
   03 Water: potable.
   04 Fiberglass Strands: 1/2 inch alkaline resistant

B. Finish Type:
   01 Acrylic Finish Coat.

C. Plaster Framing / Furring:
   01 Main Runner Channels. 1-1/2" cold rolled, hot dip galvanized channels or hat-sections; minimum 0.0538” bare steel thickness; minimum 33 KSI steel.
      a. Comply with ASTM A 653.
      b. Nominal weight: 480 PMLF.
   02 Lathing Channels. 3/4" cold rolled, hot dip galvanized channels or hat-sections; minimum 0.0538” bare steel thickness; minimum 33 KSI steel.
      a. Comply with ASTM A 653.
      b. Nominal weight: 305 PMLF.

D. Metal Lath:
   01 General: 3.4 lbs. per SY, hot-dipped galvanized.
   02 Metal Lath on Metal Plaster Framing: Expanded type, diamond shape.
   03 Metal Lath on Non-Dampproofed Solid Surfaces: Expanded type, diamond shape, self-furring.

04 Metal Lath on Dampproofed Solid Surfaces: Expanded type, diamond shape, self-furring; backed with a asphalt saturated Kraft paper (Federal Spec UU-B-790a, Type 1, Grade 2, Style 2).
05 Lath Tie Wire: minimum 18-gauge, cold drawn galvanized steel wire.
06 Lath Screws: #10 x 1-1/4", self-tapping, Round Washer Head or Modified Truss Head, K-Lath lathing screws, zinc plated.
07 Power Actuated: 3/8" diameter shank, minimum 3/4" length power actuated fasteners; zinc plated.
08 Lath Staples: Minimum 14 gauge, 1-1/2" leg, ¾" crown staples; or approved equal.

E. Accessories:
01 Pure zinc alloy or 1063 T5 aluminum unless otherwise noted.
02 Casing Bead / Plaster Stop: Design is based on Amico No. X-66 Casing Bead, with 3" wings and grounds of depth of associated plaster.
03 Control Joint: Design is based on Amico No. XJ15 Griplock J Control Joint.
04 Expansion Joint: Design is based on Amico no. 40 plaster expansion joint, grounds of depth of associated plaster.
05 Corner Bead / Key: Design is based on Fry Reglet No. PCM-75-75-150.
06 Soffit Vent: Design is based on Fry Reglet No. DS-875-V-200 or WPM-75-V-200; 2" reveal, vented soffit molding. Shape as applicable to application condition.
07 Interior Corner Reinforcement. 2" x 2" or corner master #30 USG Self-Edge Cornerite, or Cornermaster #30.
08 Drip Screed. Fry Reglet Corp., aluminum drip screed DS-875.

F. Fasteners:
01 Wire shall be galvanized annealed steel wire, in 18 gauge or 16 gauge as appropriate for use and shall comply with Federal Spec FSQQ-W-461g.AS.
02 Screws: Wafer head lathers Type S with length that penetrates steel substrate a minimum of 3/8". Comply with ASTM C 1002 and / or ASTM C 954.
03 Nails: Galvanized 11 gauge with a 3/8" diameter head and length to penetrate wood framing a minimum of 3/4". Comply with Federal Spec FF-N-105.

2.3 MIXES

A. Portland Cement Plaster:
01 Scratch Coat – Mix Proportions:
a. 1 sack Portland cement (94 lbs.).
b. 2 sacks masonry mix.
c. 9 cu. ft. sharp torpedo plaster sand.
d. 1-1/2 lbs. of 1/2" alkaline resistant fiberglass strands.
02 Brown Coat – Mix Proportions:
a. 1 sack Portland cement (94 lbs.).
b. 2 sacks masonry mix.
c. 9 cu. ft. sharp torpedo plaster sand.
d. 1-1/2 lbs. of 1/2" alkaline resistant fiberglass strands.
e. Liquid or powdered waterproofing used according to the manufacturer's recommendations.

03 Acrylic Finish Coat: Factory mixed 100% pure acrylic based integral color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cold Weather:
   01 Do not use frozen material.
   02 Do not apply cement plaster to frozen surfaces or surfaces containing frost.
   03 Do not mix materials or apply cement plaster when ambient temperature is less than 35°F/1.6°C.
   04 A temperature of at least 55°F must be maintained prior to plaster application, during its application, and until it is dry. Any plaster work, which freezes within 48 hours of application, shall be removed and replaced with new plaster.

B. Hot Weather:
   01 Protect cement plaster from uneven and excessive evaporation during hot, windy, and dry weather.
   02 Moist curing after each coat of cement plaster with water if ambient temperature is more than 75°F/24°C. Moist cure for 48 hours after application of coats.
   03 Hot, or dry, or windy weather the cement plaster should be moistened down and then covered with a single sheet of polyethylene plastic (clear only).
   04 Moist curing is required at the start and end of workday.
   05 Humidity higher than 75 percent. Moist curing not required.

C. Remove rust, oil, grease or other foreign substance which might hinder good bond from lath immediately prior to application of plaster.

D. Commencing work shall be construed as acceptance of preceding work performed by others as suitable to receive work specified in this division.

E. Erect and maintain scaffolding in accordance with all applicable laws and regulations, local or other.

F. Manufactured products shall be delivered in original packages, containers or bundles, bearing manufacturer's name and brand.

G. Mix in accordance with manufacturer's direction. Protect mixes from frost, dust and evaporation. Clean mixers, boxes and tools after each batch.

H. Mix thoroughly with correct amount of water until uniform color consistency. Measure materials accurately.

I. Mix materials dry to uniform color and consistency before adding water.

J. Mix only as much plaster as can be used in one hour.

K. Do not re-temper mixes after initial set has occurred.

L. Do not apply finish coat when there is any form of precipitation. Protect cement plaster from all forms of precipitation during the application and the setting/curing period of finish coat. Ensure that the finish is fully set prior to removing protective covering.

3.2 APPLICATION

A. Furring and Soffit Framing:
   01 Main runner channels (1-1/2") and lath channels (3/4") shall be spaced at 4'-0" O.C. and 16” O.C. respectively.
   02 The use of 16-gauge galvanized metal studs (3-5/8" wide) may be used as miscellaneous framing to achieve soffit geometry as approved by the Architect.
   03 All galvanized hanger wires shall be spaced at 4'- 0" O.C. maximum. Do not use power actuated anchors through metal deck for wire supports.
   04 Prepare all framing to receive recessed lights and control joints.
   05 Exterior soffit locations provide 1-1/2” cold rolled channel stiffeners secured to grid and structure above, space 8 ft., each way.

B. Metal Lath on Plaster Framing:
   01 Secure lath to channels by tying securely with two loops of 18 or 16-gauge tie-wire at 6" O.C. spacing maximum.
   02 Lap metal lath a minimum of 2” over supports.
   03 Apply lath with long dimension of sheet across supports.
   04 All lath shall be tightly stretched, free from looseness, bags, and bulges.

C. Metal Lath on Dampproofed Sheathing:
   01 Secure lath with screws into metal studs through sheathing. Screw lath to studs at maximum 8” O.C.
   02 Lap metal lath a minimum of 2” over stud supports.
   03 Apply lath with long dimension of sheet across supports.
   04 All lath shall be tightly stretched, free from looseness, bags, and bulges. Use additional staples as required to assure lath is flat and flush.

D. Metal Corner Beads:
   01 Provide on all external plaster corners in single lengths where length of the corner does not exceed 12 feet.
   02 Fasten securely with tie wire spaced 8" O.C. staggered in two wings.

E. Casing Beads:
   01 Install at edges of all horizontal planes and elsewhere as indicated on drawings.
   02 All junctions shall be mitered.
   03 Horizontal surfaces shall be isolated from all vertical surfaces.

F. Control Joints:
   01 It is not required to cut lath behind control points, it is required to cut lath behind expansion joints.
   02 Panels should be relatively square.
   03 Notify architect if plaster areas exceed 12 LF in length without a control joint.

04 Install control joints for surface areas of approximately 150 square feet whether shown or not. Verify locations with Architect.
05 Install where dissimilar back-up materials join whether detailed or not.

G. Soffit Vent Molding:
01 Install soffit vent molding, continuous on three sides of horizontal plaster installations.
02 Verify substrate for vent attachment and provide the appropriate type fastener for the application.

H. Portland Cement Plaster:
01 Trowel apply base coat with sufficient force to form good keys and bond. Allow to harden and scratch to produce rough surface. Keep moist until application of brown coat.
02 Apply brown coat, scratch for bond and allow to set hard. Keep moist until application of finish coat.
03 Use in all exterior locations and interior locations where noted.

I. Finish Coat:
01 Acrylic finish at all plaster areas. Mix and apply in accordance with manufacturer's written instructions. No scaffold lines or other marks are allowed due to the application. Match colors and textures of approved samples.

3.3 CLEAN UP AND PROTECTION

A. Rubbish and debris shall be removed as often as necessary. As each room or space is complete, remove all rubbish, debris, scaffolding and tools, and leave broom clean.

B. Clean plaster spots from work of other trades. Protect finish plaster from injury.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Interior metal framing – studs and joists.
   02 Interior gypsum board at walls, including trim, taping and floating.
   03 Interior gypsum board at ceilings, including trim, taping and floating.
   04 Interior glass-mat backer board at ceramic tile and masonry wall finishes.
   05 Exterior sheathing.

C. Related Work:
   01 Section 05 41 00 – Structural Metal Stud Framing
   01 Section 06 10 13 – Rough & Finish Carpentry
   02 Section 07 21 00 – Thermal Insulation
   03 Section 07 25 00 – Weather Barrier
   04 Section 09 51 13 – Acoustical Tile Ceilings
   05 Section 09 91 00 – Painting and Re-Painting

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Where proposed framing solutions exceed specified maximum allowable unbraced heights, submit engineered calculations for each specific condition; sealed and signed by a Texas licensed structural engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
   01 ASTM C473 – Standard Test Methods for Physical Testing of Gypsum Panel Products.
   02 ASTM C475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
   03 ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by Hot-Dip Process.
   04 ASTM C840 – Standard Specification for Application and Finishing of Gypsum Board.
   05 ASTM C954-10 – Standard Specifications for Steel Drill Screws for the Application of Gypsum Panel Products to Steel Studs.
   06 ASTM C1002 – 07 – Standard Specifications for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products to Steel Studs.
   07 ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
   08 ASTM C1178 – Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
   09 ASTM C1280 – Standard Specification for Application of Gypsum Sheathing.
   10 ASTM C1396 – Standard Specification for Gypsum Board.
   11 D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
   12 ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.

B. Gypsum Association:
   01 GA-214 – Recommended Levels of Gypsum Board Finish.
   02 GA-216 – Application and Finishing of Gypsum Panel Products.
   03 GA-253 – Application of Gypsum Sheathing.
   04 GA-290 – Area Separation Walls.
   05 GA-600 – Fire Resistance Design Manual.

C. National Fire Protection Association:
   01 NFPA 285 – Standard Fire Test Methods for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Materials.

1.4 DESIGN REQUIREMENTS

A. Non-Load-Bearing Metal Framing Deflection:
   01 L/360 at 5 PSF for veneer plaster and direct-applied finish materials that use grout or mortar.
   02 L/240 at 5 PSF for typical gypsum board walls.

B. Fire-Resistive Rating: Where indicated on Drawings, provide materials and construction that are identical to those assemblies whose fire resistance rating has been determined per ASTM E119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

C. Meet or exceed fire resistance requirements outlined under provisions of the GA-600 Fire Resistance Design Manual for wall and ceiling assemblies.

D. Meet or exceed Class A flame/fuel/smoke requirements of ASTM E84 surface burning characteristics for finish materials.

E. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.

F. Impact-Resistant Characteristics: No structural failure at 400 foot pounds per ASTM E195.

G. Mold-Resistant Characteristics: Rating of 10 according to ASTM D3273 mold testing.

H. Recycled Content Certification: Provide gypsum board of at least 95 percent recycled content.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or damage metal corner beads and trim.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The design of metal stud drywall framing and similar components is based on products manufactured by ClarkDietrich.

B. The following additional metal stud framing manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 Cemco
   02 Marino/Ware
   03 Mill Steel
   04 The Steel Network
   05 Telling Industries

C. Gypsum Wall Board: Provide domestically-manufactured gypsum wall board.
   01 American Gypsum
   02 Georgia Pacific
   03 James Hardie Industries
   04 National Gypsum Company
   05 Temple–Inland Forest Products Corp.
   06 U. S. Gypsum Co.

D. Exterior Sheathing:
   01 Georgia Pacific, “Dens Glass Gold” – basis of design.
   02 National Gypsum, Gold Bond ‘eXP” Extended Exposure Sheathing
   03 Temple-Inland Forest Products Corp. “Green Glass”
   04 U.S. Gypsum “Securock”

E. Glass-Mat Backer Board:
   01 USG Durock – basis of design.
   02 Certainteed
   03 James Hardie Industries

F. Substitutions of above must be approved by the Architect ten (10) days prior to Proposal / Bid Date.

2.2 STUD FRAMING MATERIALS

A. The Drawings indicate locations of partitions / stud framing and the size of the stud to be used. The Contractor is responsible for providing the appropriate stud mil thickness relative to the height and configuration of the assembly.
   01 The minimum thickness for all interior framing materials shall be 33 mils.
   02 Physical features of materials proposed to be furnished shall meet or exceed all requirements outlined below.

B. All metal framing members shall be channel type, screw type studs and runners, punched cee studs.
   01 33 mil and 43 mil material fabricated from steel with minimum 33 KSI yield strength.
   02 54 mil and heavier materials fabricated from steel with minimum 50 KSI yield strength.
   03 Conforming to ASTM C645 Standard Specification for Non-Structural Steel Framing Members.
   04 Minimum G-40 galvanized steel – ASTM A653. Galvannealed material is not acceptable. Coating equivalents are not acceptable.
   05 Provide in sizes as indicated on the Drawings and required for the actual installation assembly.

C. Interior partition and similar metal framing is based on three (3) primary stud thicknesses. The following is the minimum Mil thicknesses for studs:
   01 33 Mils minimum stud thickness to be provided at any location; unless indicated otherwise on the Drawings or required to be heavier by Specification or unbraced assembly height as determined by the installer.
   02 43 Mils (18 Gauge).
   03 54 Mils (16 Gauge).
   04 68 Mils (14 Gauge).

D. Mil thicknesses of studs shall be based on 16" O.C. framing with the maximum, laterally unbraced height at each condition in accordance with the following schedule based on gypsum board applications:

01 5 PSF at L/240 conditions; standard gyp board drywall partitions to receive a painted or vinyl wall covering finish.

Stud Size	Height 33 Mils	Height 43 Mils	Height 54 Mils	Height 68 Mils
2-1/2"	13'-10"	N/A	N/A	N/A
3-5/8"	16'-9"	18'-3"	19'-6"	20'-10"
6"	24'-9"	27'-2"	29'-2"	31'-3"

02 5 PSF at L/360 conditions; gyp board drywall partitions to receive a finish material utilizing grout, mortar or plaster.

Stud Size	Height 33 Mils	Height 43 Mils	Height 54 Mils	Height 68 Mils
2-1/2"	11'-8"	N/A	N/A	N/A
3-5/8"	14'-8"	15'-11"	17'-1"	18'-3"
6"	21'-8"	23'-9"	25'-6"	27'-3"

03 Where heights exceed limits stated above, framing at less than 16" O.C. or use of heavier mil thicknesses shall be allowed, conditional on submittal of engineered calculations for each specific condition; sealed and signed by a Texas Licensed Structural Engineer.

E. The gross Section Modulus (Sx) value for interior metal framing members shall be minimum:

Member Size	33 Mil Sx	43 Mil Sx	54 Mil Sx	68 Mil Sx
2-1/2"	0.180	0.238	0.288	0.355
3-5/8"	0.258	0.334	0.410	0.503
6"	0.520	0.675	0.832	1.026

F. All above material mil thicknesses, performance criteria and related values are minimum requirements.

01 Under NO circumstances shall any stud product less than 33 mils be acceptable.

02 Gauge equivalent / dimpled and similar products whose base materials do not meet the above criteria, performance and properties shall not be accepted under any circumstances.

03 The "ProSTUD 33" series as manufactured by ClarkDietrich meets all criteria and is acceptable. Track sections from the ProSTUD 33 system are acceptable.

04 The "ViperStud 20 STR 33 mil" series as manufactured by Marino Ware meets all criteria and is acceptable. Track sections from the ViperStud 20 STR 33 mil system are acceptable.

G. Stud tracks shall be provided in the same mil thickness or heavier than the studs they are associated with.

01 Stud sill / floor track leg height shall be minimum 1-1/4".

02 Head tracks which anchor to structural steel or floor / roof deck shall have a minimum 2" leg height (deep track) and be fabricated and installed to allow movement and flexibility of studs nested within the track.

H. Studs at all framed door and window openings shall be installed with full-height (floor to top of wall), double studs at jambs.

01 Double studs at opening shall be clipped / fastened together to result in a single composite assembly.

02 Coordinate with other trades where additional miscellaneous steel bracing is required.
03 Framed openings for mechanical ductwork and similar work shall be framed as required for the assembly.
04 Fastening studs directly to ductwork is not permitted. Coordinate with other trades as required. Adhere to U.L. requirements at fire rated partitions.

I. Metal framed partitions scheduled to receive tile finish or other applied finishes containing mortar or grout shall be increased to the next higher mil thickness for the height designated above.
01 Examples: 33 mil increased to 54 mil; 54 mil increased to 68 mil.
02 No increase is required for 68 mil framing.
03 Contractor's option: stud framing size / mils based on height limitations per above may be installed at 8" O.C. in lieu of the stated increase in mil thickness.

J. Structural metal stud bracing is required at each door opening 48" or wider.
01 Provide two (2) 54 mil studs at each jamb of frame.
02 Studs shall be fastened together to form a single composite unit.
03 Studs shall extend and be secured to steel structure above.
04 Field verify conditions and requirements.

K. Horizontal Bracing: shall be minimum 54 Mil cold rolled channels with 1/2" legs. Provide in sizes in accordance with punched openings in studs.
01 Horizontal bracing shall be either welded in place to each stud; or fastened with a clip specifically designed for the purpose.
02 Provide one row of horizontal bracing at mid-span of partitions up to 12'-0" high; and at 5'-0" O.C. for partitions higher than 12'-0".

L. Provide all accessories including, but not limited to, tracks, clips, web stiffeners, spacers, anchors, fastening devices, resilient clips, and other accessories required for a complete and proper installation, and as recommended by the manufacturer for the steel member and assembly being used.

M. Ceiling Framing:
01 U-Channel Framing: Minimum 1-1/2" x 54 mil cold rolled steel channels with hot dip galvanized finish. Use for primary framing at suspended ceilings and elsewhere as indicated.
02 Furring Channels: Standard 2-3/4" wide, 7/8" deep x 30 mil minimum galvanized sheet metal furring channels.
03 Ceiling Hanger and Tie Wire: 9 gauge galvanized hanger wire and 16 gauge tie wire.
04 Fixture Reinforcement: 6 inch, 14 gauge / 68 mil cold rolled steel galvanized channels.

N. Wall Furring:
01 Furring Channels: standard 1-1/2" and / or 7/8" deep x 30 mil minimum galvanized sheet metal 'hat section' furring channels.
02 Refer to Drawings for size at each application.

O. Metal to Metal Connections:
01 Framing fasteners shall be self-drilling / self-tapping screws.
02 Framing screws shall be #10-16x5/8" hex washer head screw.

03 Welded connections shall be fillet or flare welds as recommended by the manufacturer for the specific connection conditions.

2.3 WALL AND CEILING BOARD MATERIALS

A. General Design Basis: All gypsum wallboard shall be USG 5/8 inch thick, Type X, tapered-edged. Sizes shall be 4'-0" wide by longest practical length to minimize joints.
01 Suitable for use in fire rated assemblies.

B. Humidity Resistant Gypsum Wallboard shall be USG 5/8", Type X, Sheetrock "Mold Tough" gypsum panels.
01 Panels shall comply with ASTM D3273.
02 Use at all walls and ceilings in high humidity rooms (locker rooms, shower rooms / stalls, food service areas / rooms, restrooms, non-air-conditioned interior spaces / rooms) that do not receive a tile or masonry finish.
03 Also provide within 24" of all sinks and lavatories.

C. Tile or Masonry Finish Substrate: A cement-based backer board manufactured specifically for tile substrate and use in wet locations. Use as wall board substrate at all tile or masonry finished surfaces.
01 Minimum 5/8 inch thick.
02 Provide / install in greatest size sheets possible (48" x 96" or larger) to minimize joints.
03 Use joint reinforcement and fasteners in accordance with manufacturer's printed instructions.

D. Acceptable manufacturers / products include:
01 USG "Durock" (basis of design).
02 James Hardie Industries "HardieBacker".
03 National Gypsum "Permabase".

E. Corner Beads: Design is based on USG Dur-A-Bead Corner Bead
01 Complies with ASTM C1047
02 1-1/4" legs.
03 Material Thickness: 0.012" minimum
04 Use at all exterior corners.

F. Joint Compound (Taping): Standard types manufactured by gypsum wallboard manufacturer for intended use. Fire rated type must be used on fireproof systems.

G. Laminating Adhesives: Standard type manufactured or recommended by manufacturer of product to be laminated.

H. Gypsum board reveals shall be 1/2" wide by 5/8" deep drywall reveals; extruded aluminum, painted finish.
01 Provide where indicated on the Drawings.
02 Acceptable manufacturers / products include:
a. Gordon 'Final Forms I' Series 500 (basis of design).
b. Fry Reglet -. "DRM" Series.
c. Pittcon - "SWR" Series.

I. Control Joints: Metal type with 1/4 inch open joint, perforated flanges for floating in place.
   01 Niles Building Products model 093 Zinc Control Joint; or equal.
   02 Control joints at walls shall be located vertically.
      a. A maximum of 30'-0" O.C. floor to above ceiling.
      b. Each side of door frames from top of jamb to above ceiling.
      c. Above ceiling, cut / separate gyp board full height to top of gyp board.
   03 Control joints at gypsum board ceilings shall be located:
      a. As indicated on the Drawings
      b. Where not indicated, at a maximum of 30’-0” O.C. Coordinate with Architect for exact locations.
   04 Control joints at furdowns shall be located on all sides of the furdown at a maximum of 30'-0" O.C. to above ceiling.
   05 At building expansion joints, provide control joint full height of gyp board unless detailed or specified otherwise.

J. Exterior Sheathing:
   01 Mold-resistant, fire-rated glass-mat gypsum sheathing board.
   02 Thickness: 5/8 inch (16 mm).
   03 Properties: Enhanced mold resistance per ASTM D3273. Glass facers on both sides.
   04 Water absorption less than 6 percent per ASTM C473.
   05 Configuration: Forty-eight inches (1219 mm) wide by length required with square edges for horizontal application.

K. Fasteners (screws) shall be U.S.G. type “S” drywall screws, minimum 1-1/4” length, or longer as required to penetrate metal framing components a minimum of 1/2".

2.4 GLASS-MAT BACKER BOARD

A. Design of glass-matt backer board is based on USG Durock Tile Backerboard.

B. Treated water-resistant gypsum core that is covered with a coated fiberglass mat-facer and cementitious surface, specifically designed for use as a substrate for direct applied tile of masonry.

C. Properties:
   01 Thickness: 5/8”.
   02 Size: 48” x 96”.
   03 Mold Resistance: 10 maximum per ASTM D3273.

D. Fasteners: Design is based on USG Durock Tile Backer Screws.
   01 Length: 1-5/8”.
   02 Corrosion resistant screws complying with ASTM B117.
   03 Specifically designed for attachment of glass-mat backer board.

PART 3 - EXECUTION

3.1 METAL FRAMING INSTALLATION

A. Floor Track: Attach to floor at 24 inch maximum centers with shoot-in pins or concrete nails.

B. All metal framing shall extend to floor or roof structure / deck above, unless shown otherwise on the Drawings.
   01 Fasten tracks at 24” intervals and more often where necessary.
   02 Where framing is perpendicular to joists, provide additional bracing as required.
   03 At fire rated partitions, framing shall extend full height to floor or roof deck above to allow a full, tight fit and seal of gyp board to be applied.
   04 Where studs are indicated to extend only above ceiling, brace to structure or other suitable framing at intervals not to exceed 32” O.C. each side and staggered. Framing used for bracing shall be minimum 33 Mil members.

C. Studs:
   01 Single lengths positioned vertically in the runners, spaced 16 inches O.C. maximum unless otherwise shown.
   02 Install double studs at framed opening jambs. Install stud bracing on each side of opening at frame head height between jamb studs and adjacent studs.
   03 Secure studs to stud track on both sides at bottom track prior to installation of gyp board.
   04 Where framing extends to structure or floor / roof deck, secure studs to both sides at bottom track prior to installation of gyp board. Temporarily fasten top track to stud as required to hold plumb in place. Secure / fasten gyp board to studs +/- 1” below bottom of track leg. Do not permanently fasten gyp board or stud directly to top track. Remove temporary track fastener to provide vertical movement of studs within the top track.
   05 Where studs are indicated to extend only above ceiling, secure studs to both sides at top and bottom track prior to installation of gyp board. Brace to structure or other suitable framing at intervals not to exceed 32” O.C. one side only. Coordinate with other trades as required to avoid conflict.

D. Wall Reinforcement:
   01 Provide horizontal bridging in all stud walls in accordance with the manufacturer’s standards and recommendations.
   02 Provide solid, 2x (2x4 min.) treated wood blocking, spanning between wall studs, at all wall mounted fixtures, finish hardware, toilet partitions, wall cabinets, toilet accessories, specialties, built-in work and similar locations as required to provide a suitable substrate for firm attachment of other work.

E. Chase-Wall Bracing:
   01 Install cross-bracing for chase wall construction; Mil thickness of bracing to equal stud Mil thickness.
   02 Space braces a maximum of 36 inches vertically on every pair of studs.

3.2 WALLBOARD INSTALLATION

A. Select the maximum practical length to minimize end joints. All end joints shall be neatly fitted and staggered. Joints on opposite sides of partition shall be so arranged as to occur on different studs.

B. Install metal corner bead at external corners. Where length of the corner does not exceed standard stock lengths, use a single length.

C. Install metal trim where indicated and all wall board not terminating under frames or behind bases shall be trimmed with galvanized "J" mold.

D. Apply at least three coats of joint compound over beads, screw heads and trim, and each coat shall be feathered out onto panel faces. Refer to Paragraph 3.8 Workmanship Tolerances for level of finish required.

E. Float out and sand joints to make joints invisible when painted with non-texture paint. Refer to Paragraph 3.8 Workmanship Tolerances for level of finish required.

F. Caulk around pipes, ducts, structure or similar items which penetrate drywall systems.

G. Fasten wallboard at 12 inches O.C., except at the edges/joints which shall be at 8 inches O.C.

H. Edge-Grip Clips: Position clips on the back of the panels and drive prongs into panel edges. Space clips 16 inches O.C. Screw-attach clip to framing, furring or wall surface.

I. At all wrap-around hollow metal frames, gyp board shall extend ½" minimum into frame throat.

J. At all exterior metal framed walls extend gypsum wall board from floor to deck unless noted otherwise.

3.3 SHEATHING INSTALLATION

A. Install sheathing in accordance with manufacturer's instructions and applicable instructions in Gypsum Association -253 and ASTM 1280.

B. Install using maximum lengths possible to minimize the number of joints.

C. Secure sheathing to metal framing with hot dip galvanized screws spaced 8 inches O.C. at perimeter of board and 12" O.C. in field of board. Do not countersink fasteners; drive them to bear flush with surface of sheathing. Locate fasteners at least 3/8" from edges.

D. Provide sheathing at all exterior metal framed walls unless noted otherwise. Install with all joints tight.

E. Accurately cut and scribe at interfacing / penetrating work.

F. Coordinate with installation of dampproofing above grade.

3.4 GLASS-MATT BACKER BOARD

A. Install glass-mat backer board at all interior wall surfaces to receive direct applied ceramic or similar tile, plaster and thin-set masonry.

B. Install in full size sheets as much as possible to minimize joints.
   01 Install backer board with ends and edges closely abutted but not forced together.
   02 Stagger end joints in successive courses.

C. Fastening:
   01 For wall application, fasten glass-mat backer board to framing with specified fasteners.
   02 Drive fasteners into field of panels first, working toward ends and edges.
   03 Hold panels in firm contact with framing while driving fasteners.
   04 Space fasteners maximum 8" O.C. with perimeter fasteners at least 3/8" and less than 5/8" from ends and edges.
   05 Drive screws so bottoms of heads are flush with panel surface.
   06 Do not overdrive fasteners.

3.5 CEILING FRAMING INSTALLATION

A. Main Runners: Hanger wires (9 gauge) shall be spaced not over 4'-0" in the direction of 1-1/2 inch main runner channels, not over 4'-0" in the direction of right angles to the main runners, and within 6 inches of the ends of main runners and of boundary walls, girders or similar interruptions of ceiling continuity.
   01 Do not place over 4’-0" O.C., properly positioned and leveled.
   02 Suspension of ceiling framing from joist bridging is not permitted.

B. Furring Channels: Space 16 inches O.C., and saddle-tie with two strands of 16 gauge tie wire to main runners or main support members.
   01 Do not let into or come in contact with abutting masonry walls.
   02 End splices shall be provided by nesting channels or studs no less than 8 inches and securely wire-tie.

3.6 CEILING BOARD INSTALLATION

A. Apply gypsum board of maximum practical length with the long dimension at right angles to the furring channel and fastened with 1 inch drywall screws spaced 12 inches O.C. in the field of the board and along abutting ends.

B. Align abutting end or edge joints over the web surface of the furring channel. Tie neatly and accurately with end joints staggered.

3.7 CURVED GYPSUM WALLBOARD APPLICATIONS (PER USG #WB-1766)

A. Gypsum Wallboard: regular thickness of 1/4”, 3/8” or 1/2”, 48” wide by maximum length practical for the installation. Minimize joints.

B. Installation: Cut leg and web of top and bottom runners at 2 inch intervals for the length of the arc with 90 degree maximum uniform curve. Fasten 1 inch 18 Mil steel strip inside the cut leg of both runners with USG Metal Lock Fastener. Secure runners to framing in the floor and ceiling. Install studs between runners, twisting them into position, spaced as shown on back of this sheet. Studs may be fastened to runners to lessen their movement. However, if you must allow for deflection, cut studs 3/8 inch less than floor-to-ceiling height and do not fasten to top runner. Anchor to ceiling and floor runners a; studs for shelf-walls and walls adjacent to door/window frames, partition intersections, corners and free-standing furring. Install gypsum panels as follows:

Panel Thickness	1/4”	1/4”	3/8”	3/8”	1/2”	1/2”.
Radius	2’-0”	2’-6”	3’-0”	3’-6”	4’-0”	4’-6”
No of studs on Arc, including those at tangents	9	10	9	11	8	9
Approx. O.C. spacing	5.50”	5.93”	7.85”	7.22”	11.70”	11.40”

C. Cut gypsum board panels so that when applied horizontally they will run a minimum of 1 foot beyond the arc. Wet the side of the panel which, when hung, is in compression. Apply the amount of water as shown above with a garden sprayer. Stack panels with wet sides face to face and cover with plastic sheet. Allow to set for one hour. Install panels on the convex side of the wall first. Begin at one end of the curved surface, wrapping and fastening the panels around the framing. On the concave side of the wall, begin at the center of the curve and work out in both directions. Screw fastener spacing is 12 inches O.C. in single-layer application; 16 inches O.C. for base and 12 inches O.C. for face layer in double-layer application. Allow panels to dry for 24 hours before finishing. Finish face panel joints, internal angles and exposed fasteners with a U. S. Gypsum System applied according to manufacturer’s directions.

3.8 WORKMANSHIP TOLERANCES and REQUIRED LEVEL OF FINISH

A. Wallboard:
- 01 Visual: Correct any nicks, bumps, out-of-level or out-of-plumb areas detectable to the naked eye.
- 02 Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.
- 03 Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abuts other material or when the end is exposed.
- 04 Float control joints flush with the wall surface so that ceiling wall molds that are specified separately will align flat and straight with the wall surface.

B. Required Level of Gypsum Drywall Finish (refer to Gypsum Association publications for standards):
- 01 All gypsum wallboard shall be finished to a level 4 unless specifically scheduled or noted otherwise. All joints and interior angles shall have tape embedded in joint compound and 2 separate coats of joint compound applied over all flat joints and 1 separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with 3 separate coats of joint compound. All joint compounds shall be smooth and free of tool marks and ridges.

02 For all plenum areas and areas not exposed provide a level 1 finish. All joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

03 All gypsum wallboard scheduled to receive a semi-gloss or glossy finish shall be finished to a level 5 unless specifically scheduled or noted otherwise. All joints and interior angles shall have tape embedded in joint compound and 2 separate coats of joint compound applied over all flat joints and 1 separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with 3 separate coats of joint compound. A thin coat of joint compound or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.

3.9 COMMENCEMENT RESTRICTIONS

A. Interior gypsum wallboard and ceiling board installation may not commence until all exterior sheathing and dampproofing is completed, the individual floor is dried in or roofing is complete, roof top equipment openings are covered and flashed, and exterior wall openings are protected.

3.10 PROTECTION AND CLEAN UP

A. Coordinate with painting and make sure all gypsum board is primed and the specified texture is provided.

B. Unless the Construction Manager gives notice otherwise, in advance. Each Trade Contractor is responsible for removing his own trash from the work area and for the initial cleaning of his own work, while ongoing and when completed.

01 Garbage collections: Provide a collection can at each location on the site used as an eating area.

02 Trash removal: Clear the building and site of trash at least once a week. When rapid accumulation occurs, make more frequent removal. Remove highly combustible trash such a paper and cardboard daily.

03 Disposition of debris: Remove debris from the site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restrictions. No debris or material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials be avoiding large accumulations of combustible materials.

C. The Work shall be turned over to the Construction Manager/Owner in immaculate condition. Cleaning includes removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations and other foreign material.

D. Remove all temporary facilities.

END OF SECTION

SECTION 09 30 13

CERAMIC TILING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all floor tile products / work as indicated on the Drawings and required for a complete installation.
   02 Provide other tile products / work at other locations as indicated on the Drawings and required for a complete installation including metal transitions.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 07 92 00 – Joint Sealants
   03 Section 09 21 13 – Gypsum Board Assemblies
   04 Refer to other Division 09 Flooring Specifications as required to assure proper coordination and interface at applicable locations.

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop Drawings shall be sealed and signed by a Texas Registered Engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.
   04 Composite Sample: Submit samples of selected tile and grout mounted on a minimum 12" x 12" board, or larger if necessary, indicating tile pattern / installation, joint size and grout color.

G. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. American National Standards Institute:
   01 ANSI A108.1 – Installation of Ceramic Tile with Portland Cement Mortar.
   02 ANSI A108.4 – Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive.
   03 ANSI A108.5 – Ceramic Tile installed with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.
   04 ANSI/TCA A 108.6 – Ceramic Tile installed with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
   05 ANSI A108.10 – Grout Installation.
   06 ANSI A118.1 – Dry-Set Portland Cement Mortar.
   07 ANSI A118.4 – Latex Portland Cement Mortar.
   08 ANSI A118.6 – Specifications for Ceramic Tile Grout.
   09 ANSI A136.1 – Organic Adhesives for Installation of Ceramic Tile, Type 1 and Type 2.
   10 ANSI A137.1 – Specifications for Ceramic Tile.

B. Tile Council of North America (TCNA):
   01 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation (latest edition).

1.4 WARRANTY

A. The tile installation, including tile products, mortar adhesives and grout, shall be complete system as recommended by the manufacturer for the specific installation.

B. Provide a complete systems warranty, issued by the tile setting manufacturer that will cover the entire tile installation system against defects for a minimum ten (10) years.

PART 2 - PRODUCTS

2.1 TILE MANUFACTURERS

A. Design is based on specific products as manufactured by Dal-Tile as indicated on the Drawings or specified below.

B. The following manufacturers are acceptable provided the products proposed for use are equal to the basis of design products, including color if specific products as identified on the Drawings and / or finish schedules. Submit proposed product for review and acceptance by Architect during bidding / proposal phase. Substitution requests after bidding will not be permitted.
   - 01 American Olean Tile Co.
   - 02 Crossville
   - 03 Florida Tile Industries, Inc.
   - 04 Interceramic Tile and Stone Gallery
   - 05 Texas Cement Products
   - 06 U.S. Ceramic Tile Co.

2.2 TILE MATERIALS

A. Porcelain Floor Tile:
   - 01 Daltile “Portfolio” series
     - a. Color body porcelain tile.
     - b. Size(s): As indicated on interior finish legend
     - c. Finish: As indicated on interior finish legend
     - d. Color(s): As indicated on interior finish legend
     - e. Dynamic Coefficient of Frictions > 0.50.
     - f. Patterns shall consist of borders and other patterns as indicated on Drawings.
     - g. Provide coved tile base where indicated on the Drawings.

2.3 TILE SETTING MATERIALS

A. Mortar adhesive and grout products shall be furnished by a single manufacturer; and as a system shall be eligible to provide a system warranty.

B. Acceptable Manufacturers:
   - 01 Ardex
   - 02 Cemix / Texrite
   - 03 Custom Building Products
   - 04 Laticrete
   - 05 Mapei Americas
   - 06 Southern Grouts and Mortars

C. Cement Adhesives:
   01 Polymer / latex modified, Portland cement based mortar formulated for thin-set tile applications.
   02 In accordance with ANSI A118.15.
   03 Provide in pre-mixed bags / containers that require only the addition of water.
   04 Specific mortar adhesive shall be as recommended by the manufacturer for the intended application.

D. Epoxy Tile Adhesives:
   01 In accordance with ANSI A 118.3
   02 Provide where indicated on the Drawings, or required for setting as tile as specified by ANSI A 108.6 Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy.
   03 Epoxy mortar shall exhibit excellent non-sag and non-slump properties.
   04 Specific mortar adhesive shall be as recommended by the manufacturer for the intended application.

E. Standard Grout:
   01 Polymer modified, Portland cement based, sanded grout.
   02 In accordance with ANSI A118.7.
   03 Suitable for 1/16” to 1/8” joint widths.
   04 Color consistency throughout entire installation.
   05 Contents / additives to inhibit mold and mildew formulation and growth.
   06 Provide in pre-mixed bags / containers that require only the addition of water.
   07 Specific grout shall be as recommended by the manufacturer for the intended application.
   08 Grout color shall be as indicated on interior finish legend. If no color is indicated on the legend, the Architect shall select a color from the manufacturer’s full range of color options.

F. Epoxy Grout:
   01 High performance, cement based, epoxy grout.
   02 In accordance with ANSI A 118.3.
   03 Suitable for 1/8” to 3/8” joint widths.
   04 Color consistency throughout entire installation.
   05 Contents / additives to inhibit mold and mildew formulation and growth.
   06 Provide in pre-mixed bags/containers that require only the addition of water.
   07 Specific grout shall be as recommended by the manufacturer for the intended application.
   08 If no color is indicated on the legend, the Architect shall select a color from the manufacturer’s full range of color options.

G. Joint Sealers:
   01 High performance, single-compound, 100% silicone sealant formulated specifically for ceramic tile and stone applications.
   02 In accordance with ASTM C920 - Standard Specification for Elastomeric Joint Sealants, Type S, Grade NS, Class 25.
   03 Formulated with fungicides to resists mold and mildew growth.
   04 Color consistency throughout entire installation.
   05 Specific grout shall be as recommended by the manufacturer for the intended application.
   06 Sealant color shall match grout color as selected by the Architect from

the manufacturer's full range of color selections.

H. Crack Isolation Membrane:
   01 Design is based on Mapei Mapeguard 2 or Dal-Tile Dal-CIM 500EX or as recommended by the manufacturer.
   02 Crack isolation membrane shall be included in the system warranty.

2.4 METAL TRANSITION

A. Design is based on products manufactured by Schluter Systems.

B. Flooring Transitions: Provide the following at flooring transitions where applicable.
   01 Schluter Renu – U (AE) Satin Anodized Aluminum Tile floor to concrete, rubber, or LVT.
   02 Schluter Renu – TK (AE) Satin Anodized Aluminum Tile floor to carpet.

C. Wall Transitions: Provide the following:
   01 Schluter Rondec (AE) Satin Anodized Aluminum Tile – walls and corner edge.
   02 Schluter Rondec – DB (AE) Satin Anodized Aluminum Tile walls to epoxy base, tile wall finish, top edge.

2.5 EXTRA TILE

A. Deliver an unopened box of each color of each type of tile to the Owner at Substantial Completion.

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:
   01 Dry, clean, free of oily or waxy films, free of curing compounds.
   02 Firm and level within specified tolerances.
   03 Minimum of 40°F 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.

C. 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.

D. Where required for specified systems warranty, provide preparation materials in accordance with manufacturer's recommendations and installation instructions.

3.2 INSTALLATION

A. Unless shown otherwise on the Drawings, align joints vertically and horizontally.
   01 Where multiple tile sizes are used on the same wall / plane, arrange tiles to align common joints.

B. Use epoxy adhesive and epoxy grout at all wet locations, including, but not necessarily limited to:
   01 Restrooms
   02 Shower areas
   03 Food service areas.

C. Coordinate ceramic tile joints to align with wall expansion / control joints in CMU and framed walls.
   01 Provide non-grouted, sealed joints in ceramic tile at wall expansion / control joints.
   02 At wall expansion joints that are installed with an expansion joint cover, locate ceramic tile joints as required to accommodate the expansion joint cover.

D. Lay out tile on each wall / plane so that the minimum size tile used is not less than 1/2 tile size.

E. Where partial tile is required saw-cut to provide straight, flush, smooth edges.
   01 Where wall patterns indicated on the Drawings require cut tile (i.e. rotated accent tile, and similar), ease the edges of saw-cut tile.

F. Provide preformed inside and outside corner tile units where applicable.

G. Bullnose Tile Locations:
   01 Provide bullnose edged tile at the top course of tile that does not extend full height to ceilings.
   02 Provide bullnose edged tile at the bottom course of tile that directly above seamless epoxy flooring bases.

H. Set interior wall tile in accordance with T.C.A. Spec. W-242-19 for gypsum board substrate. Set interior wall tile on CMU in accordance with T.C.A. Spec. W-211-18.

I. Set floor tile and grout in accordance with T.C.A. Spec. F112-08. (Allow a minimum of 24 hours after tiles is set before grouting.) Slope tile to floor drains.

J. Form internal angles square.

K. Install expansion joints in accordance with T.C.A. Publication EJ171-18.
   01 Provide expansion joints at maximum 24’-0” O.C., and more often if recommended by the manufacturer for the specific installation.
   02 Additionally, align ceramic tile joints to coordinate with wall expansion / control joints.

L. Joint Sealers:
   01 Provide at all inside corners of intersecting tiled walls.
   02 Provide at all tiled terminations adjacent to door frames and other built-in assemblies.
   03 Sealed joints shall be non-grouted, and sealed continuous.

M. Clean all tile surfaces upon completion. Protect finish tile work as required from damage by other trades / activities.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL TILE CEILINGS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Ceiling suspension system
   02 Vinyl-covered gypsum board as indicated or scheduled on the Drawings.

C. Related Work:
   01 Section 09 21 16 – Gypsum Board Assemblies
   02 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections, and details.
   03 Show details of field fabrications, connections, and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop drawings shall be sealed and signed by a Texas registered engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the work of this contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples
   01 Provide two (2) samples of each finish for suspension grid and ceiling tile for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 4" x 4" for acoustical tile, and minimum 8" length of suspension grid; but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. ASTM International (ASTM):
   01 ASTM A641/A641M-09a - Zinc-coated (Galvanized) Carbon Steel Wire.
   02 ASTM A653/A653M-15e1 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process.
   03 ASTM C423-09a - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   04 ASTM C634-13 - Terminology Relating to Environmental Acoustics.
   05 ASTM C635/C635M-13a - Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
   06 ASTM C636/C636M-13 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
   07 ASTM C1396 – Standard Specification for Gypsum Board.
   08 ASTM D1779-98 - Adhesive for Acoustical Materials.
   09 ASTM E84-15b - Surface Burning Characteristics of Building Materials.
   10 ASTM E119-16 - Fire Tests of Building Construction and Materials.
   11 ASTM E413-16 - Classification for Rating Sound Insulation.
   12 ASTM E580/E580M-14 - Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
   13 ASTM E1264-14 - Classification for Acoustical Ceiling Products.

B. Underwriters Laboratory (UL)
   01 Underwriters Laboratory (UL) assemblies as required for the Work.
   02 Refer to the Drawings and other Specification sections for locations, UL Designs and requirements for fire rated assemblies

1.4 QUALITY ASSURANCE

A. Projection Conditions:
   01 Do not install acoustical ceiling until building is enclosed, sufficient heat is provided, dust generating activities have terminated and overhead mechanical work is completed, tested and approved.
   02 Maintain temperature at minimum 60 degrees F° and humidity if 40% to 50% prior to, during, and after installation.

1.5 EXTRA STOCK

A. Deliver two (2) unopened cartons of each type of ceiling board at Substantial Completion to location as directed by Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Design of Acoustical Tile Ceilings is based on the following products / manufacturers
   01 Suspension System: USG
   02 Gypsum Board Ceiling Tiles: USG
   03 Suspension Clips: Nitroset Solid Propellant Fastening System
   04 Flexible Wall Angles: Trim-Tex

B. The following manufacturers are acceptable for use for this Section, provided all specified requirements are met or exceeded.
   01 Armstrong World Industries
   02 Donn Products, Inc.
   03 USG
   04 Chicago Metallic
   05 CertainTeed
   06 Conwed
   07 National Gypsum Company

2.2 SUSPENSION SYSTEMS

A. Suspension System – Non-Fire-Rated Assemblies – Ceiling Type “A”:
   01 Design is based on USG “ZXLA” Exposed Tee suspension system.
   02 Cross Section: 1-1/2” x 15/16”.
   03 Standard hot-dipped galvanized steel body with aluminum cap (ASTM C635).
   04 Finish: Factory Pre-Painted - baked polyester.
   05 Typical Color: Flat White.
   06 Provide 9/16” x 15/16” angle molding at interface of all vertical walls. Material to match primary suspension system material(s).
   07 Provide stainless steel clips

2.3 LAY-IN TILES

A. Gypsum Board Lay-In Tiles – Non-Fire-Rated and Fire-Rated Assemblies – Ceiling Type A: Type 2 Ceilings
   01 Design is based on USG “Sheetrock Brand Lay-in Gypsum Ceiling Panels”

02 USG no. 3260, square edge, vinyl-faced gypsum with smooth texture
03 Core: Abuse-resistant, sag-resistant gypsum board.
04 Size: 24” x 24” x 1/2"
05 Finish: Smooth-textured panel - Vinyl
06 Color: white.
07 Fire Rating: UL Class A, suitable for use in rated assemblies.
08 Minimum CAC: 35 dB
09 Minimum Light Reflectance: 77%
10 Durable scrubbable and washable finish, impact and scratch resistant

2.4 OTHER PRODUCTS

A. Suspension Wire:
01 12-gauge solid, galvanized steel wire in lengths as required to overhead structural elements for the installation of each specific room / area.
02 Maximum Spacing: at 4'-0” O.C. both directions, wrapped tightly at least 3 full turns.
03 Provide a separate hanger wire at each corner of all lay-in light fixtures.
04 Verify and adhere to additional hanger and spacing conditions as required by provisions of Division 16 – Electrical, and UL Designs for rated assemblies.

B. Suspension Clips
01 Design is based on Nitroset Solid Propellant Fastening System; CLU222.
02 Configuration: Utility Clip Assembly
03 Minimum Size: 7/8” shank length; 1/8” shank diameter.
04 Allowable Loads (based on 4000 PSI concrete) at 3/4" embedment depth:
a. Tension: 120 lb.ft.
b. Shear: 165 lb.ft.
c. 45-Degree: 120 lb.ft.
05 Provide where structural conditions do not facilitate suspension wire fastening directly to steel structure.
06 Fastening to Metal Decks: Allowable only at deck valleys where a minimum of 2-1/2” depth of concrete is present.

C. Shadow Molding:
01 Design is based on USG / Donn MS-174 Shadow Molding.
02 “W” shaped molding producing a 3/8” x 3/8” reveal.
03 Provide at all conditions where lay-in ceilings interface with gyp board ceilings in the same plane.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that walls are flat and wall corners square. Commencing work shall be construed as acceptance of preceding work performed by others, as suitable to receive work specified in this Section.
01 Ceiling wall angles shall be flush with substrate.
02 Maximum deviation from flush shall be 1/16”.

B. Where suspended ceilings interface flush with other work (window / door heads, fur-downs, etc.) verify interfacing work is at correct elevation and suitable for a flush interface. Do not manipulate ceiling system to adapt to con-conforming work.

C. Ensure that wall control joints are flat and will not cause wall mold to misalign at those locations.

D. Coordinate all locations of cut tile with Architect in field, prior to commencing work.

E. Do not install any ceiling tile until all above ceiling inspections and corrections have been completed.

3.2 SUSPENDED CEILING SYSTEMS

A. General:
- 01 Ceiling grids shall be centered within each room / area unless clearly indicated otherwise on the Drawings.
- 02 Ceiling grids shall be located such that cuts at perimeter walls shall be over a half-tile unless clearly indicated otherwise on the Drawings.
- 03 Ceilings shall be installed level, within a tolerance of 1/8” per 10’-0”, non-cumulative.

B. Suspension Wires:
- 01 The intent of this specification is for the suspension wires to be wrapped around primary or secondary structural steel components where ever practical. Suspension from bridging is not permitted.
- 02 Suspension wires shall be wrapped over structural steel components and twisted a minimum of 3 times (1080 degrees).
- 03 Maximum suspension wire may be angled up to a maximum of 45 degrees.

C. Suspension Clips:
- 01 Suspension clips shall be permitted only where structural steel components do not permit installation per the paragraph above.
- 02 Architect must approve all locations where suspension clips are proposed to be fastened to metal floor or roof deck.
- 03 All connections to metal decks shall be made at the valley configuration of the metal deck surfaces.
- 04 Connection to horizontal valley surfaces of the metal deck shall be minimized; and connections shall be at the angled walls of the deck valleys.
- 05 Install suspension clips in strict accordance with manufacturer’s standards and recommendations, using manufacturer’s equipment specifically designed for the purpose.

D. Attachment of grid members to wall molding with pop rivets is not permitted.
- 01 Hanger wire at 45 degrees, approximately 10 inches long may be used to tie the grid to the wall above the ceiling to prevent eventual disengagement of the two components.

E. Install ceiling systems by skilled workmen in accordance with manufacturer's printed instructions, the reviewed shop drawings and reflected ceiling plans.

01 Exposed surfaces of acoustical units shall be level and flush, with all joints straight and true.

02 Cutting and fitting around all items protruding through acoustical ceiling shall be done neatly.

03 Wall angles and edge moldings shall have flush hairline joints, with all corners mitered.

04 Where indicated or required, install retention clips at sides of acoustical panels in accordance with manufacturer's standards and instructions.

F. Align beams or tees with angle molding at corners, unless authorized by Architect.

END OF SECTION

SECTION 09 61 43

CONCRETE FLOOR SEALER

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide concrete sealer at all interior rooms / areas scheduled to remain concrete and/or as noted on interior finish legend and plans.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

D. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

1.3 REFERENCES

A. ASTM International:
   01 ASTM C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete.
   02 ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

03 ASTM C1315 - 11 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Design is based on products manufactured by W.R. Meadows, Inc.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
01 Euclid Chemical
02 L.M. Scofield
03 Prosoco
04 ZEP Manufacturing

2.2 MATERIALS

A. Design of concrete floor sealer is based on Vocomp-25 by W.R. Meadows, Inc.

B. Concrete floor sealer shall be a water-based, acrylic curing and sealing compound specifically formulated for application on interior concrete that is exposed to water.

C. Performance Test Data:
01 ASTM C 309, Type 1, Class B
02 AASHTO M 148, Type 1, Class B
03 ASTM C 1315, Class A, Section 6.4.1 – non-yellowing
04 ASTM C 1315, Section 6.6 – exceed 50 MPa (70 psi) adhesion requirements.
05 Dried Film to be USDA accepted

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 SURFACE PRPARATION

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. Avoid puddling in low areas.

C. Protect as recommended by Manufacturer.

END OF SECTION

SECTION 09 91 00

PAINTING AND RE-PAINTING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Work under this Section includes furnishing all labor, material, equipment and accessories necessary for completion of all painting and staining.
   02 Refer to Paragraph 3.1 for list of items to receive paint.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 05 50 00 – Metal Fabrications
   03 Section 09 21 16 – Gypsum Board Assemblies

D. Work Not Included:
   01 Shop coat of paint on metal, unless noted otherwise. Exception: Shop coated / primed metal components which have had primer removed due to repair of the component (i.e. hollow metal doors frames, etc.) shall be re-primed in the field prior to application of finish painting.
   02 Aluminum and copper, unless noted otherwise.
   03 Factory finished materials, products and equipment.
   04 Plastic clad educational equipment.
   05 Refer to Section 05 50 00 – Metal Fabrications.

1.2 RESPONSIBILITY OF COORDINATION

A. Coordinate the Work specified herein with the following Work:
   01 Provide information to preceding trades for proper preparation of substrate.
   02 Inspect substrate before proceeding to verify proper preparation.
   03 Notify Architect of any item to receive paint which may not be covered by a scheduled finish type. Architect will furnish appropriate specification.

1.3 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
   01 Product data shall include test certificates / reports, other certifications and applicable documentation to demonstrate compliance and as required by the specification.

C. Samples: Submit full range of colors, patterns, textures and finishes available for selection, including the following:
   01 Color Chips: Provide complete duplicate sets of color chips for color selection.
   02 Small Applied Samples: Provide pieces of actual material on which paint will occur with minimum dry mil thickness of specified paint.
   03 Sheen Samples: Provide full range of varying sheens when sheens are controllable by intermixing.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including preparation, for all products and / or assemblies proposed to be furnished.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Installed Samples: Provide large size samples for approval. Approved samples may be left in place as part of the Work.
   01 Interior: One room and/or area, as selected by the Architect, shall be painted with materials specified or accepted and applied directly from container, un-thinned. After acceptance by Architect, room and/or area shall be standard of quality of entire project.
   02 Exterior: Three samples, 4'x4' each, of all exterior finishes, provided at the job site. Samples should represent each substrate. After acceptance by Architect, samples shall be standard of quality of entire project.

1.4 QUALITY ASSURANCE

A. Materials shall be applied directly from containers in which material is purchased. No exceptions.

B. Subcontractor shall provide to Owner and Architect a notarized certification that paint used is as specified in writing by the Architect.

C. Number of coats of each of several finishes shall be in accordance with detailed Specifications, which will produce first quality finish if properly applied.
   01 If number of coats specified fails to produce a finish acceptable to Architect, this Contractor shall apply additional coat(s) at his own expense until an acceptable finish is achieved.

D. At painted CMU walls in food service, culinary and other similar health-sensitive areas, the application of the paint system and final finish shall fill voids and irregularities in the CMU and produce a substantially smooth, easily cleanable surface acceptable to the Authority Having Jurisdiction.

E. Provide primers and other undercoat paints produced by same manufacturer as finish coats. Use thinners recommended by paint manufacturer's printed instructions.

F. Deliver products to jobsite in unbroken containers bearing manufacturer's labels, intact and legible at time of use.

1.5 WARRANTY

A. The undertaking of a painting subcontract will indicate that the subcontractor will warrant the Work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance, resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include by not be limited to the following:
   01 Discoloring noticeably by yellowing, streaking, blooming, changing color or darkening.
   02 Mildew.
   03 Peeling, cracking, blistering, alligatoring or releasing from the substrate.
   04 Chalking or dusting excessively.
   05 Changing sheen in irregular fashion.
   06 Change in sheen and / or color resulting from re-application of paint using a different application method than use on original coating(s) (i.e. brush touch-up on a surface originally sprayed).
   07 Softening or becoming tacky.
   08 Bubbling.

C. In the event of damage, immediately make all repairs and replacements necessary for approval of the Architect, and at no additional cost to the Owner.

1.6 PRODUCT HANDLING

A. Store only approved materials at the jobsite, storing only in a suitable and designated area restricted to the storage of paint materials and related equipment.

B. Temperature in the storage area shall be between 40°F and 110°F. Open and mix all materials in the storage area.

C. Use all means necessary to protect materials before, during, and after application, and to protect the installed work and materials of all other trades.

D. Apply water-based paints only when temperature of surfaces to be painted, and surrounding air temperatures are between 50°F (10°C) and 90°F (32°C), unless otherwise permitted by paint manufacturer's printed instructions.

E. Apply solvent-thinned paints only when temperature of surfaces to be painted, and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C), unless otherwise permitted by paint manufacturer's printed instructions.

F. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions. Painting may be continued during inclement weather, if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer, during application and drying periods.

1.7 EXTRA STOCK

A. Upon completion of the Work of this Section, deliver to the Owner, an extra stock equaling 10 percent or a minimum of 1 gallon, whichever is greater, of each color, type, and gloss of paint used in the Work.
   01 Make sure each container is tightly sealed, clearly labeled with contents, and location where used.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. All paint materials selected for coating systems for each type of surface shall be the product of a single manufacturer and shall, as a system, have flame spread, fuel contribution, and smoke density test results less than 25.

B. Paint materials listed herein, unless otherwise designated in the "Painting Schedule", are the products of Sherwin Williams., and require no further approval as to manufacturer or catalogue number.

C. Similar first line material of one of the following manufacturers may be used subject to approval by the Architect for items indicated to be coated with Sherwin Williams materials:
   01 Benjamin Moore Co. (Moore)
   02 ICI Paint

2.2 EXTERIOR PAINT MATERIALS

A. The following is a Specification of typical exterior painted items and does not specifically include every item that is to receive paint.
   01 It should, however, establish type and quality of finish for all items normally included in a complete paint job.

B. Exterior Galvanized Metal:
   01 1 coat – SW Pro-Cryl Universal Water Based Primer B66-310 Series. 2.0 – 4.0 mils DFT.
   02 2 coats – SW DTM Acrylic Gloss Coating B66W100 Series. 2.5 – 4.0 mils DFT each coat.

C. Field Weld Touch-up on Galvanized Metal:
   01 1 coat – SW Pro-Cryl Universal Water Based Primer B66-310 Series. 2.0 – 4.0 mils DFT.
   02 2 coats – SW DTM Acrylic Gloss Coating B66W100 Series. 2.5 – 4.0 mils DFT each coat.

D. Ferrous Metals:
   01 1 coat – SW Pro-Cryl Universal Water Based Primer B66-310 Series. 2.0 – 4.0 mils DFT.
   02 2 coats – SW DTM Acrylic Gloss Coating B66W100 Series. 2.5 – 4.0 mils DFT each coat.

E. Exterior Wood:
   01 1 coat – SW A-100 Alkyd Wood Primer Y24W20. 2.3 mils DFT.
   02 2 coats – SW DTM Acrylic Gloss Coating B66W100 Series. 2.5 – 4.0 mils DFT each coat.

F. Exterior Concrete Masonry Units:
   01 2 coats – SW Loxon XP Exterior Waterproofing System A24-1400 Series, 6.4 – 8.3 mils DFT each coat.

G. Exterior Concrete Tilt-Wall – Smooth Coating:
   01 1 coat – SW Loxon XP Waterproofing Coating A24-100 Series, 6.4 – 8.3 mils DFT.
   02 2 coat – SW Conflex XL High Build Smooth, A05W00451, 6.0 – 7.5 mils DFT each coat.

H. Exterior Concrete Tilt-Wall – Medium Textured Coating:
   01 1 coat – SW Loxon XP Waterproofing Coating A24-1400 Series, 6.4 – 8.3 mils DFT.
   02 1 coat – SW Conflex XL High Build Medium Texture, A05W00810, 9.4 – 11.0 mils DFT.

I. Exterior Plaster (designated “Acrylic Finish”):
   01 1 coat – SW Loxon Conditioner A24-100.
   02 2 coats – Sherwin Williams UltraCrete Textured Masonry Topcoat A44 Fine Texture, 6.0 mils DFT.

J. Exterior Traffic Marking Paint:
   01 1 coat – SW Setfast Solventborne Acrylic Traffic Parking Paint, 15.0 mils WFT, 7.2 mils DFT.

2.3 INTERIOR PAINT MATERIALS

A. The following is a Specification of typical interior painted items and does not specifically include every item that is to receive paint.
   01 It should, however, establish type and quality of finish for all items normally included in a complete paint job.

B. Interior Gypsum Drywall and Ceilings – Enamel Finish:
   01 1 coat – SW Promar 200 Zero VOC Latex Primer B28W02600. 1.1 mils DFT.
   02 2 coats – SW Promar 200 Zero VOC Latex B24-2600 Series. 1.4 mils DFT each coat.

C. Interior Gypsum Drywall and Ceilings – Epoxy Finish:
   01 1 coat – SW Preprite 200 Latex Primer B28W200. 1.1 mils DFT.
   02 2 coats – SW Water Base Catalyzed Epoxy B70 / B60. 3.0 mils DFT each coat.
   03 Use at bathrooms, locker rooms, showers, science labs, food service areas, unconditioned areas, and other moist / wet areas.

D. Interior Galvanized Metal:
   01 1 coat – SW ProCryl Water Based Universal Primer B66-310 Series. 2.0 – 4.0 mils DFT.
   02 2 coats – SW ProClassic Waterborne Acrylic S/G Enamel B31W51 Series. 1.4 mils DFT each coat.

E. Interior Non-Galvanized Metal:
   01 1 coat – SW ProCryl Water Based Universal Primer B66-310 Series. 2.0 – 4.0 mils DFT.
   02 2 coats – SW ProClassic Waterborne Acrylic S/G Enamel B31W51 Series. 1.4 mils DFT each coat.

F. On Metal with Shop Coat, use:
   01 Touch-up Shop Coat with SW ProCryl Water Based Universal Primer B66-310 Series, 2.0 – 4.0 mils DFT.
   02 2 coats – SW Pro Classic Interior Alkyd Semi-Gloss B34 Series.
   03 Used for hollow metal door / window frames and miscellaneous steel items.

G. On steel joists and wood fiber decks:
   01 Coordinate with manufacturer for preparation and application on existing assemblies.
   02 Prime as required with primer as recommended by the manufacturer for rusting surfaces, peeling paint etc.
   03 2 coats - SW Dry Fall - Waterborne Acrylic Dry Fall, B42W1, 3.5 mils DFT each coat.

H. Interior CMU – Enamel Finish:
   01 2 coats - SW Loxon Block Surfacer A24W200. 8.0 mils DFT each coat.
   02 2 coats – SW ProClassic Waterborne Acrylic S/G Enamel B31W51 Series. 1.4 mils DFT each coat.

I. Interior CMU - Epoxy Finish – Wet Areas:
   01 2 coats – SW Kem Cati-Coat Filler B42 Series. Total 15 to 25 mils DFT. As required to fill voids and provide a continuous surface.
   02 2 coats – SW Water Base Catalyzed Epoxy B70 / B60. 3.0 mils DFT each coat.
   03 Use at showers, food service areas, unconditioned spaces, and other moist / wet areas as indicated.

J. Interior CMU - Epoxy Finish – Dry Areas:
   01 2 coats Loxon Block Surfacer A24W200. Total 16 mils DFT as required to fill voids and provide a continuous surface.
   02 2 coats – SW Water Base Catalyzed Epoxy B70 / B60. 3.0 mils DFT each coat.

K. Interior Wood – Enamel:
   01 1 coat – SW Preprite Classic Latex Primer B28W101. 1.6 mils DFT.
   02 2 coats - SW ProClassic Waterborne Acrylic S/G Enamel B31W51 Series. 1.4 mils DFT each coat.

L. Interior Wood – Stained Transparent Finish:

01 SW Wood Classics Stain A49 Series. Coordinate with Architect for specific stain color, application and final appearance to be used for each interior wood stained surface.
02 2 coats - SW Wood Classics Polyurethane Varnish A67 Series, 1.7 mils DFT each coat.

2.4 COLORS

A. Where specific finished paint colors are indicated or scheduled on the Drawings, provide paint colors accordingly.

B. Where specific finished paint colors are not indicated or scheduled on the Drawings, different colors may be selected for each room, and more than one color may be selected in each room.

C. Multiple paint colors and / or patterns on a single wall or plane shall be as indicated on the Drawings.

D. All piping in mechanical rooms shall be painted in their entirety in accordance with the following color schedule:
01 Natural Gas ..... Orange
02 Domestic Cold Water .... White
03 Domestic Hot Water ..... Pink
04 Heating Hot Water ..... Red
05 Condenser Water ..... Green
06 Chilled Water ..... Blue

PART 3 - EXECUTION

3.1 ITEMS TO RECEIVE PAINT

A. Generally, all unfinished items that are normally painted in any typical building, including but not limited to the following list:
01 All ferrous metal including exposed steel structure; excluding mechanical and equipment rooms.
02 All exposed exterior steel; including masonry lintels, exposed steel structure, handrails and other exterior steel components.
03 All exterior wood.
04 All interior wood.
05 All conduit, outlet boxes and electrical cabinets exposed within a user occupied rooms; excluding those located in mechanical / electrical rooms.
06 All exposed pipe, plumbing and ductwork, including those located in mechanical rooms.
07 All new metal grilles, except aluminum, unless otherwise indicated.
08 All new exposed gypsum board surfaces, including all mechanical rooms.
09 All exposed exterior concrete masonry units, including all mechanical rooms.
10 All exposed interior concrete masonry units, including all mechanical rooms.
11 All exposed cementitious wood fiber materials at roof deck and walls.
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 new exposed mechanical equipment and electrical equipment.
15 Any other material that is exposed to view that is not prefinished.

B. All work where a coat of material has been applied must be inspected and approved by the Architect, before application of succeeding specified coat, otherwise no credit for coat applied will be given.
01 Notify Architect when a particular coat has been completed for inspection and approval.
02 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.

3.2 PREPARATION

A. Preparation of materials shall be in accordance with the manufacturer’s standards and / or recommendations for the paint products / systems specified for each material.
01 Field verify all conditions and requirements and coordinate with manufacturer as required for a proper installation.

B. General: Surface must be clean to ensure adhesion. Remove oil and grease with paint thinner. Wash off dirt with warm soapy water and rinse with clean water. Remove rust by wire brushing or sanding.

C. Unfinished Surfaces:
01 Wood: Sand smooth and apply one coat of primer undercoat. After primer has dried overnight, putty nail holes and cracks, then spot-prime putty with primer. Again, allow the primer to dry overnight, sand lightly and topcoat.
02 Masonry and Concrete: Remove form release compounds, efflorescence or cement dust on masonry and concrete by etching with a 10% solution or muriatic (Hydrochloric) acid. Power wash surface after etching with clean water, and paint while still damp, but within manufacturer’s moisture tolerance. On surface where muriatic acid cannot be used to neutralize the efflorescence, remove the efflorescence by sanding, scraping or wire brushing, and apply a coat of masonry conditioner before painting. Fill voids and pores in concrete masonry and other porous masonry materials with latex block filler and allow to dry overnight before top coating.
03 Iron and Steel: Prime with metal primer and allow to dry overnight before top coating.
04 Galvanized Metal: Prime with galvanized metal primer and allow to dry overnight before top coating.

3.3 APPLICATION

A. General: Surfaces to be finished must be clean, dry, and free of dirt, oils, loose paint or any other contamination that would adversely affect adhesion, protective properties or appearance of the coating.

B. Allow exterior paints to dry 72 hours between coats and interior paint to dry 24 hours between coats.

01 Allow all enamels and varnishes to dry 24 hours between coats. If enamel and varnishes are tacky after 24 hours, allow additional time until finish is dry.

C. Leveling: Apply with proper consistency and quality so paint flows out to a level surface free of brush and roller marks, bubbles, dust, runs, sags, and holidays. Spread evenly.

D. Appearance: Uniform color, texture and sheen.

E. Acrylic coating on concrete tilt-wall system to be applied with 1000psi airless sprayer with heavy duty texture gun.

F. Neatness: Paint shall not be smeared, spattered or run over adjoining colors or materials. Cut-on lines shall be straight.

G. First coat shall be white, unless otherwise specified.

END OF SECTION

SECTION 10 10 00

MISCELLANEOUS SPECIALTIES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Rapid Entry Systems (Fire Department Lock Box)
   02 Loading Dock Bumpers
   03 Coiling Overhead Wind Screen
   04 Hitching Rail
   05 Bird Screens
   06 Steel Tube Panels – Cattle
   07 Steel Tube Gate in Frame – Cattle
   08 Arena Soil Mix
   09 Wooden Barn Doors
   10 Reach-in Cooler (Concessions)
   11 Resilient Rubber Base

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.

01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.

PART 2 - PRODUCTS

2.1 RAPID ENTRY SYSTEM (FIRE DEPARTMENT LOCK BOX)

A. Knoxbox
01 Knox box 3200 series by Knox Company
02 Surface mount with hinged door, without UL Listed Knox Tamper Alert.
03 1/4” plate steel housing, 1/2" thick steel door with interior gasket seal and stainless-steel door hinge.
04 Box and lock UL listed. Lock to have 1/8” thick stainless-steel dust cover with tamper seal mounting capability.
05 Exterior Dimensions: 4”H x 5”W x 3-7/8”D.
06 Lock: UL Listed. Double-action rotating tumblers and hardened steel pins accessed by a biased cut key.
07 Finish: Knox-Coat proprietary finishing process.
08 Color: To be selected by Architect from manufacturer’s standard colors.
09 Quantity:
a. Provide one (1) surface-mounted box at the front entry.
b. Provide one (1) at each traffic gate.
10 Mount per manufacturer’s recommendation.
a. Cabinet to be mounted 36 inches to 72 inches above the finished floor or as directed by AHJ.

B. Loading Dock Bumpers
01 Laminated Dock Bumper by Durable Corporation or approved equal by Kelley Co., Inc. (4Front), or Rite-Hite.
02 Bumpers: Durable Laminated Rubber Dock Bumper. Fabric reinforced rubber pads laminated between structural steel angles and secured with 3/4 inch (19mm) steel supporting rods.
a. Projection from Wall: 4-1/2” (114 mm).
b. Vertical Height: 12 inches; 4 inch bolt hole centers
c. Length: 18 inches
d. Finish for exposed metal: Powder coated black
03 Install every 6 feet o.c. along entire side of dumpster ramp at location(s) indicated on drawings.

C. Coiling Overhead Wind Screen:
01 High-strength vinyl tarp as manufactured by Shur-Co Products or approved equal.
02 Super Duty 22 oz.
03 Length:
a. Twelve (12) feet at cattle pens, unless noted otherwise.
b. Six (6) feet at hog/lamb pens, unless noted otherwise.
04 Height: 8 feet exposed curtain

05 Approximately 21 percent of curtain surface shall be perforated. Screen shall be able to stop 90 percent of the wind.
06 Screen color to be selected by architect from Manufacturer's standard colors.
07 Provide 2 inch O.D. galvanized sched. 40 steel pipe at bottom of wind screen.
08 Provide #3 rolled rimmed brass grommets at 2'-0" O.C.
09 Provide 2" hem double stitched.
10 Provide pocket for installation of 2x4 treated wood.

D. Bird Screen:
01 Galvanized Wire Mesh by Nixalite of America, Inc. or equal provided by American Fence & Company or Louis E. Page, Inc.
02 1/2 inch square mesh
03 Steel, 19 gauge wire, hot dipped galvanized after weld
04 Provide all accessories required for a complete installation.

E. Steel Tube Panels and Gates - Cattle
01 Classic Series Panels and Gates by WW Manufacturing
02 Size:
a. Steel Tube Panels: 72 inches high x width as indicated
b. Steel Tube Gates: 84 inches overall frame height, 82 inches clear under top horizontal frame rail x width as indicated.
03 Fabrication:
a. Top and bottom horizontal rails, equally spaced intermediate horizontal rails, vertical end posts and intermediate vertical spacers: 2 inch OD, 14 gauge high tensile steel tubing, 50,000 psi yield strength.
b. Saddle cut and weld all joints. Provide a hole at one end for galvanizing after fabrication.
c. Provide a minimum of 2 mounting clips welded to each end post.
d. All panels shall have 1, 2, 3, and 4-way pins. Include clips and drop-pins to receive and secure panels and gates.
e. Panels and gates to mount on separate posts.
f. Gates Hardware:
1. Latches: Spring activated
2. Hinges: 2-inch standard pipe hinge

F. Arena Soil Mix:
01 Masonry Sand Mix meeting ASTM C144
02 Depth: 6 inches

G. Wooden Barn Doors
01 Outdoor Rated Bi-Parting Double Barn Door as manufactured by Rustica or approved equal by Simpson Barn Doors, VT Industries (Eggers collection), Assa Abloy, or Tennessee Barn Doors.
a. Material: Solid Cedar, premium grade.
b. Style: Z style
c. Size: As indicated on drawings. Doors to extend beyond opening a minimum of 6 inches.
d. Thickness: 1-3/4 inch minimum
e. Finish: Stained, color to be selected by Architect.
f. Space between meeting edges of pair of doors: 1/8 inch
g. Rated for exterior use

02 Hardware:
- a. Approved Manufacturers: Rustica, National Hardware, Crown Industrial, Assa Abloy, and Allegion.
- b. Finish: Galvanized
- c. Steel box track with wall-mounted box rail bracket. Holes to be pre-drilled.
  1. Track Length: Two times width of door.
- d. Provide metal corner plates at each corner of door.
- e. Weight Capacity: As required to support weight of door, 250 lbs minimum
- f. Provide dual hangers (2 min per door), adjustable stops, adjustable floor guide, spacers, soft-close (pre-installed), and padlock hasp.
- g. Rail edges and core exposed by hardware cutouts shall be factory sealed.
- h. Rated for exterior, heavy-duty use

H. Reach-in Cooler:

01 Reach-in Glass Swing Door Refrigerator with Hydrocarbon Refrigerant - Framed Door TS-Series by True Manufacturing Co., Inc., or approved equal.

02 Model TS-49G-HC ~ FGD01.
- a. Doors: 2
- b. Shelves 6

03 Size: 54-1/4”W x 29-7/8”D x 78-3/8” H

04 Stainless steel interior and exterior front and sides, matching aluminum back.

05 Welded, heavy duty steel frame rail, black powder coated.

06 4” diameter stem castors with locks on front set.

07 Energy Efficient, Low-E, double pane thermal glass doors with locks.
- a. Provide magnetic door gaskets of one piece construction, removable without tools for ease of cleaning.

08 LED interior Lighting, safety shielded.

09 Exterior temperature display.

10 Evaporator to be epoxy coated

11 Adjustable, heavy duty PVC coated shelves
- a. Six (6) shelves per unit.
- b. Four (4) chrome plated shelf clips per shelf.
- c. Shelves to be adjustable on ½” increments.

12 Positive seal, self-closing doors. Lifetime guaranteed door hinges and torsion type closure system.

13 Bottom mounted condensing unit, easily accessible condenser coil for cleaning.

14 Electrical requirements:
- a. Horsepower: 1/2
- b. Voltage: 115/60/1
- c. Amps: 5.4
- d. Cord Length: 9 feet

15 Quanty: Two (2)

16 Location: Concessions 100

I. Resilient Rubber Base:

01 Manufacturers: Design of resilient materials is based on specific products, finishes and colors as manufactured by Roppe as identified on the Drawings.

a. The following manufacturers are acceptable provided the products proposed for use are equal to the basis of design products, including color if specific products as identified on the Drawings and / or finish schedules.
   1. Burke-Mercer
   2. Flexco
   3. Johnsonite
   4. Nora Rubber Co.
   5. R.C. Munson

02 Materials:

a. Base:
   1. Design is based on Roppe Pinnacle Rubber Cove base.
   2. Quality Standard. ASTM-1861-98, Type TS 100% rubber base with matching end stops and molded corner units.
   3. Type. Top-set cove; standard toe.
   4. Length: 48".
   5. Height. 4" inches, unless shown otherwise.
   6. Thickness. Full 0.125.
   7. Color. As indicated on interior finish legend. If not color is indicated, architect to select from manufacturer's standard colors.

b. Resilient Reducer Strips:
   1. 1" wide x 1/8" thick, rubber, tapered or bullnose edge, color as selected by Architect from manufacturer's standard colors.

c. Primers and Adhesives:
   1. Concrete Slab Primer: Non-staining type as recommended by material manufacturers.
   2. Adhesives: Waterproof, stabilized type as manufactured by resilient material manufacturer.
   3. Adhesives shall be capable of use on concrete slabs with 95% Relative Humidity (RH).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in strict accordance with manufacturer's installation instructions and recommendations specific to this installation.

B. Coordinate with other trades as required.

C. Adjust for proper installation.

END OF SECTION

SECTION 10 11 23

TACK BOARDS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all tack boards as indicated on the Drawings.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 09 21 16 – Gypsum Board Assemblies

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. ASTM International:
   01 ASTM E84 - Standard Test Method for Surface Burning Characteristics for Building.
   02 Materials ASTM B221 - Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.

1.4 WARRANTY

A. All tack boards shall be warranted for 50 years under normal use against material defects, warping, and delamination of laminate facing and becoming unserviceable.

B. Any defects noted during the warranty period shall be corrected at no cost to the Building Owner. Such corrective work shall include all labor and material for repair, replacement, refinishing and re-hanging as required.

C. Provide Manufacturer’s executed, written 50-year warranty with close-out documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of tack boards is based on products manufactured by Claridge.

B. The following additional manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 ASI Group
   02 Best-Rite
   03 Carolina Specialties
   04 Moore Company
   05 Nelson Adams
   06 Peninsular Slate
   07 Platinum Visual Systems

2.2 MATERIALS

A. Factory Built Tack Board (TB):
   01 Design of tack board is based on Claridge Classic Bulletin Board Cabinet.
   02 Frame:
      a. Radius edge cabinet, constructed fo 1-1/2” x 3” hollow tube perimeter trim with satin bronze anodized finish. Inside depth to be 1-3/4”
      b. Provide 3/16” tempered glass doors with continuous hinges and flat key tumbler locks, keyed to District’s masterkey system.

03 Tack Surface: Claridge “Fabricork” vinyl plastic mounted on 1/4 inch resilient cork over 1/4 inch hardboard underlayment (1/2 inch total thickness).
04 Patterns and colors as selected by the Architects from manufacturer’s full range of standard colors.
05 Size: 48” height by length indicated on the drawings. Where no length is indicated, provide 72” units.
06 Provide micro-vented cabinet to reduce potential for mold and mildew growth.

B. Mounting:
01 Mount factory assembled boards with mounting clips only; no adhesive is to be used.
02 Mount all tack boards at 34" AFF.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate with other trades as required for installation of blocking in walls to secure the tack board support brackets.

B. All tack boards and accessories shall be installed in strict accordance with manufacturer’s printed instructions.

C. Provide all grounds, brackets, anchors, trim, and accessories for a complete installation.

D. Mount tackable wall surface to wall substrate in strict accordance with manufacturer’s standards and recommendations.

END OF SECTION

SECTION 10 14 00

SIGNAGE

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Room identification signs.
   02 Dedication Plaques.
   03 Exterior wall-mounted aluminum letters.
   04 Exterior wall-mounted specialty graphics
   05 Panel Site Signage

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 09 21 16 – Gypsum Board Assemblies
   03 Section 09 91 00 – Painting and Re-Painting

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.

02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3” x 3” but must be large enough to convey attributes of the proposed product.

G. Sample / Mock-Up:
01 Provide a full size, completed sample of an interior room graphic sign.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
01 ASTM B209 Specification for Aluminum and Aluminum Alloy Sheet and Plate.
02 ASTM E284 Standard Definition of Terms Relating to Appearance of Materials.
03 ASTM E308 Computing the Colors of Objects by Using the CIE System.
04 ASTM E1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation.

1.4 QUALITY ASSURANCE

A. Work of this Section shall comply with applicable requirements of the Handicapped Accessibility Act of Texas, as codified in Section 7, Article 601b, Vernon’s Texas Civil Statutes.

PART 2 – PRODUCTS

2.1 INTERIOR ROOM GRAPHICS AND SIGNAGE

A. Design of interior room graphics and signage is based on products manufactured by South Texas Graphics.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
01 Architectural Graphics Products (APG)
02 Corpus Christy Stamp Works
03 Genesis Graphics and Signs
04 ASI Sign Systems, Inc.

C. Materials and Fabrication:
01 Core Material: 1/4" acrylic.
02 Face: Horizontal grade plastic laminate.
03 Design: as indicated on the Drawings.
04 Dimensional characters shall be precision-cut from acrylic and chemically welded to the acrylic core through precision cut-outs in laminate face.
05 Characters shall be raised a minimum of 1/32” above the laminate face.

06 Where shown on the design, fabricate to allow for replaceable sliding identification graphic inserted from either side of the sign. Provide a rigid, clear plastic acrylic cover at slot.
07 All signs shall be furnished with raised Grade II Braille perma-dots in accordance with ADA standards and requirements.

D. Mounting:
01 Install interior signage with perimeter of foam tapes and center fill of clear silicone adhesive.
02 Locate on wall adjacent to strike side of door at consistent height and distance to door frame throughout the building.
03 Where sign is mounted on a glass surface, provide a solid back-up plate of same color to cover on the reverse side on glass.

2.2 DEDICATION PLAQUES

A. Design of interior room graphics and signage is based on products manufactured by A.R.K. Ramos Architectural Signs.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
01 Essential Architectural Signs
02 Ornamental Arts Company
03 ASI Sign Systems, Inc.

C. Materials and Fabrication:
01 3/4” thick cast aluminum with a brushed aluminum finish and stipple textured dark oxidized background.
02 Plaque dimensions, font style and sizes, and edging as indicated on Drawings.
03 Raised letters in satin finish as shown on the Drawings.
04 The grade 2 Braille shall be an integral part of the casting.

D. Fasteners and Attachment Hardware: Concealed fasteners and hardware of size and type recommended by manufacturer for attachment of plaque to wall.

E. Provide all materials required for a complete installation.

2.3 CAST ALUMINUM LETTERS / GRAPHICS

A. Design of cast aluminum letters is based on products manufactured by Woodland Manufacturing.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
01 A.R.K. Ramos
02 Gemini
03 Southwell Company

C. Cast aluminum letters / graphics shall be used for the school name mounted on an exterior wall of the building.

D. Building Name / Signage:

01 Material: Aluminum 319 Alloy.
02 Edge: Square.
03 Case: all capitals.
04 Finish: Dark Bronze Anodized
05 Height: 24” tall letters.
06 Building name to be “WEST AGRICULTURAL SCIENCE FACILITY”.
07 Mounting: pin mounted with aluminum or stainless-steel studs for mounting to masonry veneer.
08 If location is not identified on drawings, locate per architect in field.

2.4 SPECIALTY GRAPHICS

A. Design of custom specialty graphics are based on products manufactured by Humble Sign Co. or approved equal.

B. Material: Dibond Aluminum

C. Size: as indicated on drawings

D. Artwork/image files to be provided by the Architect and/or Owner.
01 Exterior shall be tiger logo as shown on exterior elevations and rendering on cover sheet.
02 Interior shall match Tomball West High School logo as shown on interior elevations.

E. Provide up to three (3) colors per each sign.

2.5 PANEL SITE SIGNAGE (POST AND PANEL SIGNS)

A. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
01 ABC Architectural Signage
02 Architectural Graphic Products
03 ASI Sign Systems
04 Best Manufacturing Company
05 Environmental Graphic Systems, Inc.
06 South Texas Graphic Specialties, Inc.

B. Panel Signs:
01 Smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions.

C. Material: .
01 Face panel: 080 aluminum, bronze anodized.
02 Posts: 2” x 2” x 1/8”

D. Letters to be white, size as indicated on drawings.

E. Size: As indicated on drawings.

F. Fasteners:
01 Use concealed fasteners fabricated from metal that are not corrosive to the sign and mounting surface.

G. Anchors and Inserts:
   01 Use nonferrous metals or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts as required to be set into concrete or masonry work.

2.6 MISCELLANEOUS SIGNAGE

A. Exterior Building Address:
   01 Provide 6” high white vinyl numbers at front entry door 1014-1 with the building's numerical address at the location shown on the drawings.
   02 Provide 6” high white vinyl numbers at press box and field house with building’s numerical address if required by AHJ.

B. Exit Door Number Signage
   01 Provide .040 aluminum sign with number designation. Background color to be gloss white.
   02 Size of sign to be 6” high x 9” wide with 1/2" radius corners.
   03 Text shall be 4-inch high, gloss black numbers. Center text in sign.
   04 Install in numerical order at all primary and secondary entry/exit doors, starting with the number “1”. Door numbers to begin at the main entry doors and continue clockwise from true north.
   05 Adhere to door with double-sided tape.
   06 Provide two (2) signs per door. One (1) shall be installed on exterior side of door and one (1) sign shall be installed on interior side of door.
   07 Where sign is mounted on a glass surface, signs shall be back-to-back.
   08 Sign to be attached with mechanical fasteners or clear, double-sided VHB Tape.

PART 3 - EXECUTION

3.1 INSTALLATION - INTERIOR ROOM GRAPHICS / SIGNAGE

A. All room graphics shall be firmly affixed to substrate without use of mechanical fasteners.

B. Mount graphics at a uniform height and distance from adjacent door jamb in accordance with ADA and Texas Accessibility Standards.

C. Where graphics are mounted on glass, provide a corresponding plastic laminate surfaces graphic blank on the inside of the glass.

3.2 INSTALLATION – CAST METAL DEDICATION PLAQUE

A. Install in strict accordance with manufacturer’s installation instructions and recommendations specific to this installation.

B. Coordinate with Architect for specific location and height of plaque.

C. Install with concealed fasteners filled with cement.

3.3 INSTALLATION – CAST ALUMINUM LETTERS / GRAPHICS

A. Install in strict accordance with manufacturer's installation instructions and recommendations specific to this installation.

B. Coordinate with Architect for specific location and height of school name mounted on exterior masonry veneer.

C. Carefully lay out location of mounting studs on masonry veneer on building and cast stone substrate at marquee using template provide by manufacturer.
   01 Drill holes to accept mounting studs per manufacturer's specifications.

D. Install cast aluminum letters and numbers, firmly fixing mounting studs in place.

3.4 INSTALLATION – PANEL SITE SIGNAGE

A. Install in strict accordance with manufacturer's installation instructions and recommendations specific to this installation.

B. Install where indicated in documents.

END OF SECTION

SECTION 10 14 53

TRAFFIC SIGNAGE

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide signage at all handicap parking spaces in accordance with ADA and TAS standards, and as indicated on the Drawings.
   02 Provide all exterior traffic signage as indicated on the Drawings.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 05 12 00 – Structural Steel Framing
   03 Section 05 50 00 – Metal Fabrications
   04 Section 10 14 00 - Signage

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Show signage layout site plan.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.

02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3” x 3”, but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
01 ASTM A500, Cold formed welded and seamless carbon sheet structural tubing in rounds and shapes.
02 ASTM B209 Specification for Aluminum and Aluminum Alloy Sheet and Plate
03 ASTM D523 Standard Method for Test for Specular Gloss
04 ASTM D4956 Standard Specification for Retroreflective Sheeting for Traffic Control
05 ASTM E284 Standard Definition of Terms Relating to Appearance of Materials
06 ASTM E308 Computing the Colors of Objects by Using the CIE System
07 ASTM E810 Standard Test Method for Coefficient of Retro-reflection of Retroreflective Sheeting
08 ASTM E1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation

B. Regulatory Agencies:
01 Local Authority Having Jurisdiction. Verify requirements and comply with AHJ requirements.
02 Manual on Uniform Traffic Control Devises (MUTCD)
03 Standard Highway Sign Design (SHSD)
04 Texas and Texas Manual of Uniform Traffic Control devices (TMUTCD).
05 Americans with Disabilities Act (ADA)
06 Texas Accessibility Standards (TAS)

PART 2 - PRODUCTS

2.1 TRAFFIC SIGNAGE

A. Substrate (Sign Blanks).
01 This shall be minimum 0.080” for signs up to 12” x 18” and 0.125” for larger signs.
02 Aluminum alloy 5052-H38 and otherwise in conformance with ASTM B209 and have gold chromate finish.
03 The type of signs shall be as indicated on the standard detail sheet in the plans.
04 Size. The dimensions of substrate applications for regulatory, warning, and guide signs shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD) for residential areas.
05 Metal working. The aluminum shall be free of burrs and pits on both sides, including edges and holes, and shall be made ready for applications of the sheeting.

06 Surface Preparation. The aluminum shall be thoroughly cleaned and degreased with solvent and alkaline emulsions cleaner by immersion, spray, or vapor degreasing and dried prior to application of the gold chromate sheeting coat.

07 The aluminum shall be new and corrosion-free with holes drilled or punched, corners rounded to the radii shown in the standard detail sheet, and all edges smoothed prior to application of sheeting.

08 The heavy or medium chromate coating shall conform in color and corrosion resistance to that imparted by the Alodine 1200F treatment.

B. Sign Face (Background, Legends, Symbols, and Colors). These shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD).

01 The sign face, made of electronic film and retro-reflective sheeting shall comply with appearance, specification, and good workmanship designated by the using agency for sign faces constructed of screen processed retro-reflective sheeting of the same type.

02 All sign blanks shall be covered with appropriate retro-reflective sheeting.

03 All ground mounted stop signs, warning signs, and other regulatory signs, shall use at a minimum High Intensity Prismatic Reflective Sheeting.

04 Provide verbiage, directional arrows and similar information on signs as indicated on the Drawings.

C. Sign Posts**.** Steel post shall conform to the standard specification for hot rolled carbon sheet steel, structural quality, ASTM designation A570, Grade 50.

01 Average minimum yield strength after cold forming is 60,000 psi.

02 All sign posts shall be either nominal 2” diameter or 2” x 2” square pipe.

03 Provide caps at all posts.

04 All sign posts shall be hot-dipped galvanized.

05 Provide in length required for industry standard mounting height plus a minimum of 24” to be embedded in a minimum 12” diameter x 24” concrete footing

D. Accessibility Signage

01 Accessibility signage shall be installed at each handicap designated parking space.

02 For sign installed in non-traffic locations (i.e. on an adjacent sidewalk or in a grade area) posts shall be nominal 2” diameter or 2” x 2” square pipe with cap, embedded a minimum 24” below grade.

03 ADA Handicap Parking signs located within parking lots shall be mounted on 2” x 12” x 1/4" structural rectangular tubes with welded 1/4" cap plate, embedded a minimum 24” below grade. Finish shall be painted as directed by the Architect.

04 All posts shall be hot-dipped galvanized after fabrication. Informational signage shall be standard sizes, shapes, colors and text as required by the ADA or TAS standards.

E. Accessories:

01 Provide standard mounting brackets and hardware to affix sign to posts.

02 All hardware shall be stainless steel.

03 All hardware shall have vandal-proof heads.

PART 3 - EXECUTION

3.1 INSTALLATION – TRAFFIC SIGNAGE

A. Install in strict accordance with manufacturer's installation instructions and recommendations specific to this installation.

B. Coordinate with Architect for specific locations.

C. All traffic signage shall be mounted at standard MUTCD regulatory heights.

D. Unless shown otherwise, set all sign posts a minimum 24" below grade in a minimum 12" diameter x 30" deep concrete footing.

01 At grade areas, the top of the footing shall be +/- 2" below finish grade to allow installation of topsoil and / or sodding.

END OF SECTION

SECTION 10 44 00

TOILET, BATH AND LAUNDRY ACCESSORIES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

.

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Furnish and install toilet and bath accessories as indicated or scheduled on the Drawings or specified herein and at revised existing toilet stalls.
   02 GC responsible for Installation of Items Provided by Owner:
      a. Soap dispensers - surface mounted.
      b. Roll Paper towels dispensers - surface mounted.
      c. Toilet tissue dispensers- surface mounted.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 09 21 16 – Gypsum Board Assemblies
   03 Section 09 30 13 – Ceramic Tiling
   04 Section 10 21 13.19 – Plastic Toilet Partitions

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication, and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections, and details.
   03 Show details of field fabrications, connections, and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

G. Operations and Maintenance Manuals
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to section 01 78 23 – Operations and Maintenance Manuals
   03 O & M manuals must be reviewed, accepted, and delivered to the Owner prior to Owner demonstration(s).

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. ASTM international:
   01 ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   02 ASTM A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
   03 ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
   04 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 QUALITY ASSURANCE

A. Manufacturer: Provide products manufactured by a company with a minimum of ten (10) years successful experience manufacturing similar products.

B. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.

C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.

D. Hazardous Materials: Comply with EU Directive "Restrictions of Hazardous Substances (RoHS) requirements."

1.5 WARRANTY

A. Provide a written warranty for all provided stainless steel components covering the stainless-steel finish against rust and / or rust spots for a period of two (2) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General design is based on products manufactured by Bobrick.

B. The following additional manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 A & J Washroom Accessories
   02 American Specialties
   03 Bradley
   04 Charles Parker Co.
   05 GAMCO, General Accessory Mfg. Co.
   06 Watrous, Inc.

C. Specified products listed by other manufacturers comply with district standards and are listed as no substitutions.

2.2 MATERIALS

A. Stainless Steel:
   01 Alloy: AISI, Type 302 or 304 (18-08) ASTM A167.
   02 Finish: No. 4 satin, unless otherwise specified.
   03 Thickness: US Stainless 22 gauge minimum.

B. Aluminum:
   01 Extruded: 6463-T5 alloy, anodized.
   02 Cast: 356 or 356-T6 alloy.

C. Chromium Plating:
   01 Method: Over nickel.
   02 Standard: ASTM B177, Type SC 2.

D. Brass:
   01 Cast or forged.
   02 QQ-B-626C.

E. Mirrors: (Framed)
   01 Standard: Federal Standard A-A-3002.
   02 Glass thickness: 1/4 inch minimum.
   03 Backing: Electrolytic cooper.
   04 Protection: Padding and filler strips.
   05 Frame: Type 304 stainless steel, satin finish.

PART 3 - EXECUTION

3.1 MOUNTING LOCATIONS

A. Refer to Drawings for mounting locations. When not shown, submit supplier's recommendations for locations and mounting height before proceeding.
   01 For Owner Furnished Contractor Installed (OFCI) accessories, coordinate with Owner to obtain cut sheets and mounting instructions for all accessories.

B. Coordinate with other trades as required for opening sizes for recessed and semi-recessed accessories, installation of blocking in walls, and electrical connections to accommodate the installation of all toilet and bath accessories.
   01 All wood blocking shall be treated.
   02 Wood blocking shall be sized to accommodate anchorage of toilet accessory and provide minimum toilet accessory weight requirements.
      a. Grab Bars: 250 LBS
      b. Shower Seats: 360 LBS.

3.2 INSTALLATION

A. Install all toilet and bath accessories in strict accordance with manufacturer's standards and recommendations.

B. Use concealed fastening where possible; and where not possible, use approved theft-resistant type fasteners for anchoring toilet accessories.

C. Comply with ADA requirements.

PART 4 - SCHEDULES

4.1 ITEM LIST

A. As a quality standard, model numbers shown are Bobrick Washroom Equipment unless indicated otherwise.

B. TA-1 – Wall Mounted Soap Dispensers:
   01 Owner Furnished - Contractor Installed.
   02 Provide one (1) at every single sink location.
   03 At multiple / gang sink locations, provide quantities indicated on the Drawings.
   04 Mounting: Surface with concealed fasteners.

C. TA-2 – Mirrors:
   01 Bobrick Model No.: Series 290 series stainless steel framed mirror without shelf.
   02 Mounting: Surface with concealed fasteners.
   03 Sizes Above Lavatories and Sinks: Minimum 24" x 36". Refer to Drawings for other sizes.
   04 Full Height Mirrors: Minimum 24" x 72". Refer to Drawings for other sizes.

D. TA-3 – Paper Towel Dispenser:
   01 Owner Furnished - Contractor Installed.
   02 Provide one (1) at every single sink location.
   03 At multiple / gang sink locations, provide quantities indicated on the Drawings.
   04 Mounting: Surface with concealed fasteners

E. TA-4 – Recessed Waste Receptacle
   01 Not Used

F. TA-5 - Toilet Paper Dispenser:
   01 Owner Furnished - Contractor Installed.
   02 Location: One at each toilet.

03 Mounting: Surface with concealed fasteners

G. TA-6 - Grab Bars – Toilet Compartments:
01 Standard Accessible Stall: Bobrick Model No.: B-6806.99 x 36 and x 42 in each 60” wide standard accessible stall.
a. At toilets where flush valve assembly interferes with accessible mounting height of rear grab bar, provide vertical sweep or bend on the vertical water supply to the flush valve.
b. Field verify all conditions.
02 Ambulatory Accessible Stall: Bobrick Model No.: B-6806.99 x 42 (2) in each 36” wide ambulatory accessible stall.
03 Mounting: Surface with concealed fasteners and theft-proof covers.

H. TA-7 - Mop and Broom Holder:
01 Bobrick Model No.: B-223 x 36, four holders.
02 Mounting: Surface.
03 Location: One at each mop sink, whether indicated or not.

I. TA-8 – Clothes / Towel Hooks:
01 Bobrick Model: B-233.
02 Mounting: Surface (48” AFF).
03 Location: One at each toilet stall door, whether indicated or not and one (1) at single use restrooms mounted on back of solid core wood door and as indicated on drawings.

J. TA-9 – Feminine Napkin Dispenser:
01 Model No.: B-2800 25.
02 Mounting: Surface with concealed fasteners.
03 Operation: Single coin (25 cents).
04 Capacity: 31 Napkins/22 Tampons.

K. TA-10 - Feminine Napkin Disposal:
01 Model No.: B-270.
02 Mounting: Surface with concealed fasteners.
03 Liners: Provide 4 oz. liner units, No. B-270-12.2.
04 Location: One at each women’s toilet stall, whether indicated on drawings or not.

L. TA-11 - Grab Bars – Shower Compartments:
01 Not Used

M. TA-12 - Folding Bench – Shower Compartments:
01 Not Used

N. TA-13 - Shower Curtains and Rods:
01 Not Used

O. TA-14 - Electric Hair Dryer:
01 Not Used

P. TA-15 - Electric Hand Dryer:
01 Model: B-750.
02 Mounting: Recessed with concealed fasteners (maximum 4” protrusion from wall.
03 Height above finish floor to activation device: Men at 46”; Women at 44”.

Q. TA-16 – Baby Changing Station:
   01 Bobrick / Koala Kare Model: KB-200.
   02 Polypropylene body with steel hinge system, and complete with liner dispenser and liners.
   03 Mounting: Surface with concealed fasteners.
   04 Height above finish floor: 32” to bottom of unit.

R. TA-17 – Shower Water Retainer:
   01 Not Used

S. TA-18 – Accessible Toilet Stall: General designation to identify assembly

T. TA-19 – Ambulatory Toilet Stall: General designation to identify assembly

U. TA-20 – Standard Toilet Stall: General designation to identify assembly

V. TA-21 – Accessible Sink: General designation to identify assembly. Refer to plumbing drawings.

W. TA-22 – Standard Sink: General designation to identify assembly. Refer to plumbing drawings.

X. TA-23 – Transfer Type Shower Compartment: General designation to identify assembly

Y. TA-24 – Roll-in Shower Compartment: General designation to identify assembly

Z. TA-25 – Hi/Lo Electronic Drinking Fountain: General designation to identify assembly. Refer to plumbing drawings.

END OF SECTION

SECTION 10 44 13

FIRE EXTINGUISHERS AND CABINETS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide fully recessed fire extinguisher cabinets where indicated on the Drawings.
   02 Fire extinguishers shall be GC Furnished installed.
   03 Provide fire extinguisher wall brackets at all mechanical rooms and electrical rooms.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 09 21 16 – Gypsum Board Assemblies

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3” x 3” but must be large enough to convey attributes.

G. Operations and Maintenance Manuals
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to section 01 78 23 – Operations and Maintenance Manuals
   03 O & M manuals must be reviewed, accepted, and delivered to the Owner prior to Owner demonstration(s).

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of fire extinguisher cabinets and fire extinguishers is based on products manufactured by JL Industries.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
   01 Apex
   02 Potter Roemer
   03 Uline

2.2 MATERIALS

A. Fire Extinguisher Cabinets: Design is based on JL Industries Cosmopolitan Series, semi-recessed cabinets with 1-1/2” projection, model number 1036V – Vertical Duo.
   01 24” x 10- 1/2” x 5-1/2” inside box dimension.
   02 Semi-recessed type with 1-1/2 inch return trim, square edge with eased corners.
   03 Stainless steel door with handle and silk-screened lettering “Fire Extinguisher” with wire glass.
   04 Hinge: Concealed.
   05 Provide a handle and magnetic catch with keyed lock.
   06 Finish of Exterior: Stainless steel.
   07 Finish of Interior: Standard.
   08 All fire extinguisher cabinets shall be furnished with 10 lb. fire extinguisher.

B. Wall Mount Brackets:
   01 Provide manufacturer’s standard fire extinguisher wall bracket specifically suited for support of wall mounted fire extinguishers.

C. Fire Extinguishers (Standard):
   01 Multi-purpose dry chemical with UL 4A-60B:C and FM approved; UL 2A-10B:C for 5 and 10 lbs.

02 Capacity: 5 lb. At mechanical rooms and direct wall mounted extinguishers; and 10 lb. at fire extinguisher cabinets.

03 Extinguishers are furnished for direct wall mounting and for fire extinguisher cabinets. Refer to Drawings for location and quantity.

04 Provide initial inspection tag for each extinguisher.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with other trades as required for installation of rough openings / recesses in walls to receive fire extinguisher cabinets.

B. Coordinate with other trades as required for installation of all blocking in walls necessary for proper installation of fire extinguisher cabinets and wall mounted brackets.

3.2 INSTALLATION

A. Install fire extinguisher cabinets in strict accordance with manufacturer's standards and final reviewed submittals.

B. Install fire extinguishers at all cabinets and wall hung locations.

C. Provide initial inspection tag for each extinguisher immediately prior to Substantial Completion.

END OF SECTION

SECTION 10 56 26

INDUSTRIAL METAL SHELVING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements including Section 012500 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide all industrial metal shelving units indicated on the Drawings or specified here in.

C. Related Work:
   01 Section 05 50 00 – Metal Fabrications.
   02 Section 13 34 19 – Metal Building Systems

1.2 SUBMITTALS

A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the work of this contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of industrial metal shelving is based on products manufactured by Uline.

B. The following additional manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
   01 Penco.
   02 Lyon-MF.
   03 Dixie Shelving Co.
   04 Global Industrial.

2.2 MATERIALS – AG BARN

E. Design of industrial metal storage shelving is based on Uline Heavy-Duty Steel Shelving.

F. General:
   01 Adjustable heavy-duty steel shelves.
   02 Nominal Size: 36”W x 24”D x 84"H.
   03 Minimum Shelf Capacity: 4000 lbs. uniformly distributed load.
   04 Quantity: As indicated on drawings.

G. Shelf Unit Components:
   01 Corner Post: 14 gauge minimum.
   02 Shelf Gauge: 16 gauge minimum.
   03 Shelves: Six (6) shelves total per unit, including top and bottom.
   04 Two pair side sway braces per unit.
   05 One pair back sway braces per unit.

H. Finish: Gray powder coat paint, factory applied.

2.3 MATERIALS – FIELD HOUSE

A. Design of industrial metal storage shelving is based on Uline Heavy-Duty Steel Shelving.

B. General:
   01 Stainless Steel Wire Shelving
   02 Material: Type 304 stainless steel
   03 Nominal Size: 36”W x 18”D x 86"H.
   04 Minimum Shelf Capacity: 800 lbs. uniformly distributed load.
   05 Quantity: As indicated on drawings.

C. Shelf Unit Components:
   01 Shelves: Six (6) shelves total per unit, including top and bottom.
   02 Two pair side sway braces per unit.
   03 One pair back sway braces per unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install shelving units in accordance with manufacturer's printed instructions.

B. Secure wall units to walls in a minimum of two places per unit. Connection can be made with angle brackets.
   01 At metal framed wall conditions, assure connection at wall is made into a stud.

02 Connection into gyp board (alone) or use of expansion anchors is not acceptable.

C. Refer to Drawings for locations and quantities.

D. Install bottom shelf 1'-0" above finish floor.

END OF SECTION

SECTION 10 73 26

ALUMINUM WALKWAY COVERINGS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements including Section 012500 – Request for Substitution Procedures.

B. Refer to Section 01 25 00 – Request for Substitution Procedures.

C. Scope of Work:
   01 Provide walkway canopy systems / assemblies in the configurations and heights indicated on the Drawings.
   02 All walkway canopies shall be engineered by Structural Engineer licensed in the State of Texas.
   03 All walkway canopies shall be engineered to meet minimum wind load criterion established for this project.
   04 Design of walkway column / post footings shall be included. Coordinate with the Contractor for installation responsibility.

D. Related Work:
   01 Section 02 32 00 – Geotechnical Report
   02 Section 03 30 00 – Cast-In-Place Concrete
   03 Section 32 13 13 – Concrete Paving and Flatwork
   04 Division 26 – Electrical

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop Drawings shall be sealed and signed by a Texas Registered Engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

1.3 REFERENCE STANDARDS

A. ASTM International:
   01 ASTM B221 - 08 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   02 ASTM B429/B429M – 06 Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

B. Aluminum Association: AA-MIO-C22-A21: Aluminum Design Manual 2005, The Aluminum Association.

C. ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures.

D. AAMA – American Architectural Manufacturers Association.

E. AWS D1.2/D1.2M:2003, Structural Welding Code – Aluminum.

F. Underwriters Laboratories: Class A Fire Rating.

1.4 SYSTEM REQUIREMENTS

A. Aluminum walkway covers shall be a complete, engineered canopy system comprised of support columns, cross beams, bent framed, decking and fascia trim.
   01 Refer to Drawings to layout, configurations and heights.

B. All aluminum walkway covers shall be designed and engineered to withstand wind loads per IBC codes and as specified in Section 01 11 23 – Code Summary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of aluminum walkway canopies is based on products / systems / assemblies of Avadek Walkway Cover Systems and Canopies.

B. The following manufacturers are acceptable to provide work of this Section provided all proposed products meet or exceed specified requirements:
   01 Aluminum Techniques
   02 Canopy Solutions
   03 The Chism Company
   04 Eastern Metal Supply
   05 East Texas Canopy
   06 Rusco Custom Canopies
   07 Superior Metal Products Co.

2.2 MATERIALS

A. Aluminum extrusions shall be as designed by manufacturer and appropriate for intended use.
   01 6005-T6.
   02 6061-T6.
   03 6063-T5.
   04 6063-T6.
   05 All alloys shall be in accordance with ASTM B221.

B. Provide 6” x 6” and 6” x 10” aluminum beams, or larger if required by engineering, draining the canopy as shown on Drawings.
   01 If drainage is not indicated, provide drainage at least at every other column / post on one side of the walkway canopy only.
   02 Drainage shall be away from the building; and conform to drainage patterns as indicated on the Drawings.

C. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and hurricane winds, in the configurations as shown on Drawings.

D. Provide concealed drainage from deck into gutters and into bents, for discharge at slab, trench drain or subsurface level as indicated on the Drawings.
   01 At Surface Drains: Provide angled, aluminum diverter welded in the base of the column to divert water onto adjacent surface.
   02 At Trench Drains: Provide extended column to extend flush with top of trench drain cover.
   03 At Subsurface Drains: Provide a horizontal, round aluminum, 12” long boot welded to side of column at required elevation to interface with subsurface storm drain system. Provide threaded end for PVC/SDR fitting to connection to subsurface storm system. Flexible Fernco or equal type fittings are NOT allowed. Coordinate with other trades as required for size, location and depth.

E. Bent Construction: Beams and columns shall be welded into one-piece rigid bents in the manufacturer’s shop. Extended structural ties shall be rigidly installed in tops of all beams, also serving as closures between draining deck sections.

F. Horizontal 6” x 6” U-beams and vertical 6” x 6” tubes are to attach to columns and each other with concealed fasteners to recessed aluminum plates.

G. Roof Deck:

01 Minimum Panel Overall Profile Height: 4-1/2”.
02 Roof sections shall interlock in a homogeneous structural unit, with joint designed and fabricated into a structurally rigid shape which is self-flashing.
03 No protruding ribs on the underside of deck is permissible.

H. Fascia: 10” height.

I. Finishes: finishes of each component shall be as selected by the Architect from manufacturer’s full range of colors samples.
01 Anodized Finish: bronze. Minimum Class I, 0.7 mils, 215 R-1, AA-C22A41.

J. Expansion Joints: Provide expansion joints as required. Expansion joints shall have no metal-to-metal contact.

2.3 FOUNDATIONS

A. Design of footings at canopy columns shall be the responsibility of the canopy manufacturer.

B. Footings shall be designed to support all dead loads, live loads at a minimum of 20 PSF, and as required to meet specified wind load / uplift.

C. Coordinate as required for preparation and installation of canopy footings.

2.4 DRAINAGE SYSTEMS

A. Drainage Above Grade / Flatwork:
01 Provide openings in base of columns: with bottom of opening +/- 4” above grade or concrete flatwork where indicated on the Drawings.
02 If not indicated, provide drainage at a minimum of every other column on canopy side away from the building toward the nearest paving.
03 Provide a minimum 1/4" thick diverter plate welded continuous into base of drainage columns to provide positive diversion of water out of drainage opening.

B. Drainage Below Grade:
01 Provide opening in drainage columns below grade.
02 Provide a minimum 1/4" thick diverter plate welded continuous into base of drainage columns to provide positive diversion of water out of drainage opening.
03 At column opening, provide a round aluminum boot, 12” in length, welded continuous onto face of column at drainage opening below grade and threaded on the outer end to connect with PVC/SDR female threaded fitting.
04 Diameter of boot shall be equal to sub-surface drainage pipe shown to connect to drainage column. Refer to Civil Storm Sewer Drawings.
05 Connection to underground storm drain pipe shall be accomplished with a female threaded PVC/SDR fitting. Flexible Fernco or equal type fittings are NOT allowed.
06 Column footing shall be below drainage connection; adjust column length as required.
07 Coordinate with other trades as required to properly locate and connect the drainage boot.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install at locations shown on the Drawings.

B. Provide concrete footings in accordance with engineer's signed and sealed Shop Drawings.

C. Follow manufacturer's printed instructions.

D. Coordinate dimensional requirements prior to fabrication.

3.2 ERECTION

A. Erection shall be in accordance with manufacturer's recommendations.
   01 Erectors shall be manufacturer approved.

B. Erect after all structural concrete and masonry in vicinity is complete and washed down.

C. Column sleeves shall be furnished by the manufacturer and installed by the General Contractor, to elevations and dimensions on approved Shop Drawings.

D. Erect all bents straight and true. Protect columns with heavy plastic sheeting.

E. Install all flashing required at the juncture of deck sections.

3.3 CLEANING AND PROTECTION

A. Remove all protective sheeting from metal panels and fascia.

B. Care shall be taken to prevent damage or scratching. Damaged or scratched components will not be accepted.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

C. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work: Provide all residential / commercial appliances indicated on the Drawings, including, but not limited to:
   15 RIce Makers

C. Related Work:
   15 Division 22 – Plumbing
   16 Division 26 – Electrical

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

D. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

E. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembly components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

F. If products are provided by an acceptable manufacturer not used in the basis-of-design, provide Shop Drawings indicating revisions required to adjacent or interfacing assemblies.

G. Operations and Maintenance Manuals
   01 Provide complete operations and maintenance manuals to the Owner.
   02 Refer to section 01 78 23 – Operations and Maintenance Manuals
   03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of ice machines is based on products manufactured by Manitowac.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide ice machine products of this Section, provide all proposed products meet or exceed the specified requirements.
   01 Hoshizaki
   02 Scotsman
   03 Subzero
   04 U.S. Ice Machine Mfg. Co.

C. All appliances shall meet the requirements of Americans with Disability Act (ADA) and Texas Accessibility Standards (TAS).

2.2 ICE MACHINE – CONCESSIONS 100

A. Free-Standing Ice Machine: Design of free-standing ice machine is based on Manitowoc Model RNP0320A Nugget Ice Machine on D-420 Ice Bin with 6” adjustable legs.
   01 Size:
      a. Ice Machine: 22”W x 23.63”D x 36” H
      b. Bin: 22”W x 34”D x 44”H
   02 Bite sized nugget ice, ranging in size from 3/8” to 1/2” in width and length on average, 85% ice to water ratio.
   03 Up to 308 lbs. of daily ice production.
   04 Bin Storage: 310 lbs.
   05 Air-cooled.
   06 BTU per hour: 7,511 (average).
   07 Compressor: Nominal Rating: ¾ HP
   08 Refrigerant: R290.
   09 Water Pressure Ice Maker Water in:
      a. Min. 14 psi
      b. Max 80 psi
   10 Electrical:
      a. Minimum circuit ampacity: 7.5 amps
      b. Maximum fuse size: 15 amps
      c. 115/60/1

B. Connect with existing utilities as required.

C. Warranty:
   01 Ice maker: 3 years parts and labor
   02 Compressor: 5 years parts, 3 years labor.

D. Quantity: One (1). Locate at Concession 100 where indicated on drawings.

2.3 ICE MACHINE – STORAGE 107

A. Free-Standing Ice Machine: Design of free-standing ice machine is based on Manitowoc Model RNF-1100A Nugget Ice Machine on D-570 Ice Bin with 6" adjustable legs.
   01 Size:
      a. Ice Machine: 30"W x 23.62"D x 27.40" H
      b. Bin: 30"W x 34.50"D x 44"H
   02 Bite sized nugget ice, ranging in size from 3/8" to 1/2" in width and length on average, 85% ice to water ratio.
   03 Up to 1158 lbs. of daily ice production.
   04 Bin Storage: 430 lbs.
   05 Air-Cooled.
   06 BTU per hour: 7,500 (average).
   07 Compressor: Nominal Rating: 1.5 HP
   08 Refrigerant: R404A
   09 Water Pressure Ice Maker Water in:
      a. Min. 20 psi
      b. Max 70 psi
   10 Electrical:
      a. Minimum circuit ampacity: 14.2 amps
      b. Maximum fuse size: 20 amps
      c. 208-230/60/1

B. Connect with existing utilities as required.

C. Warranty:
   11 Ice maker: 3 years parts and labor
   12 Compressor: 5 years parts, 3 years labor.

D. Quantity: One (1). Locate at Storage 107 where indicated on drawings.

PART 3 - EXECUTION

3.1 COORDINATION AND PREPARATION

A. Where appliances are shown to be built into casework and other assemblies, coordinate with other trades as required to provide proper clearances and installation of appliances.

B. Coordinate with electrical, mechanical and plumbing trades as required for proper connection and interface with appliances.

3.2 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Adjust for proper operation.

END OF SECTION

SECTION 11 66 53.20

ATHLETIC SPORTSFIELD NETTING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

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PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Structural steel pipe column supported net backstop at competition soccer field at location(s) indicated on drawings.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 05 50 00 – Metal Fabrications

1.2 SUBMITTALS

A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Site Plan Drawings:
   01 Site plan (and more detailed plan where necessary) showing layout of all proposed sportsfield netting.
   02 Indicate height, size, material, and finish.
   03 Include details of post anchoring / footings, joints, attachments and clearances of all components.

E. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the work of this contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

F. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.

01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

G. Samples: Submit sample of netting.

1.3 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. Defects shall include, but not be limited to the following:
01 Rough or difficult operation.
02 Loose or missing parts.
03 Noticeable deterioration of finish.

1.4 SYSTEM REQUIREMENTS

A. Sportsfield netting shall be a complete, engineered system comprised of support columns and nets.
01 Refer to Drawings for configurations.

B. All sportsfield netting shall be designed and engineered to withstand wind loads per IBC codes and as indicated on code analysis sheet.

PART 2 - PRODUCTS

2.1 FLEXIBLE NET BACKSTOPS

A. Nylon netting backstops supported on minimum 8” diameter structural-steel, hot-dipped pipe supports.
01 Nominal height: 20’-0”
02 Configuration: Nominal overall lengths indicated on drawings

B. Nets to be #21 nylon 1 ¾” mesh weather treated with hemmed edges.

C. Hardware:
01 Suspension cable: 3/8” galvanized aircraft cable; minimum 15,000 lb. tensile strength.
02 Galvanized 3/8” cable clamps.
03 Galvanized 3/4" eyebolts.
04 Galvanized quick snaps.
05 All other hardware and accessories required for a complete installation.

D. Suspension system: Provide suspension system allowing netting to be raised and lowered from ground level for erection and removal / storage.

E. Acceptable Manufacturers:
01 America’s Nationwide Netting, Inc.
02 Atec Sports
03 BSN Sports
04 Mid American Sports Advantage (MASA).
05 Nets of Texas
06 Tomark Sports, Inc.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with other trades as required for the proper installation / interface of work included in this Section.
   01 Coordinate for all concrete footings to be installed and included in Contractor’s proposal if work is excluded under this Section.
   02 Coordinate for all structural steel supports to be installed and included in Contractor’s proposal if work is excluded under this Section.

B. Do not proceed until all discrepancies and issues have been fully resolved.

3.2 INSTALLATION

A. Install per manufacturer's printed instructions.

END OF SECTION

SECTION 11 68 33.13

SOCCER FIELD EQUIPMENT

CONDITIONS OF THE CONTRACT, SECTIONS AA THROUGH CB AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Furnish and install soccer goals at locations indicated on drawings.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 11 66 53.20 – Athletic Sportsfield Netting

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide manufacturer's product information for all products proposed to be furnished.

C. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

D. Samples: Submit sample of netting.

1.3 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. Defects shall include, but not be limited to the following:
   01 Rough or difficult operation.
   02 Loose or missing parts.
   03 Noticeable deterioration of finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   01 BSN Sports
   02 Gill Athletics (Porter)
   03 Jaypro

04 SportsEdge
05 Sportsfield Specialties

2.2 EQUIPMENT

A. Soccer Goals:
01 Design is based on Gill Athletics U90 World Cup Soccer Goal Package R-485200
02 Size: 24’-0” wide x 8’-0” deep; in compliance with NFHS standards.
a. Bottom of horizontal crossbar shall be located 8’-0” above the playing field, with the uprights positioned with a 24'-0” inside dimension.
03 Crossbar and Uprights: Constructed of 4” diameter lightweight high-tensile (6063-T6) aluminum extrusion finished in a durable white powder-coated finish.
a. All aluminum extrusion sections shall be designed with an internal continuous channel configuration, and furnished with special molded, high-tensile nylon no-tie net attachment clips for ease of installing or removing the nets.
b. Upright corners shall be reinforced with built in welded 11-gauge tubular steel corner brackets. Uprights shall be secured to the crossbar with welded steel brackets.
04 Accessories:
a. No. 00404-000 Ground Sleeves
b. No. 00069-204 Upright Padding
c. No. 291200 Standard Backstays
d. No. 00491-824 Soccer Net (Pair)
05 Uprights shall extend 2’-0” minimum into concrete footings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Carefully lay out / locate goal post sleeves.

B. Coordinate with other trades as required for installation of sleeve footings.

C. Finished installation shall comply with all Texas UIL standards and requirements. Verify all conditions.

D. Do not proceed until all discrepancies and issues have been fully resolved.

3.2 INSTALLATION

A. Install per manufacturer's printed instructions; complete with all specified accessories required for a complete installation.

END OF SECTION

SECTION 12 32 16

MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Plastic laminate clad casework.
   02 Plastic laminate clad countertops.
   03 Casework hardware and accessories.
   04 Other miscellaneous plastic laminate clad work as indicated on the Drawings.

C. Related Work:
   01 Section 04 20 00 – Unit Masonry
   02 Section 06 10 00 – Rough Carpentry
   03 Section 09 21 16 – Gypsum Board Assemblies
   04 Division 22 – Plumbing
   05 Division 26 – Electrical

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Submit a copy of the Specification Section with any / all proposed deviations clearly marked and identified in red text / markings.
   01 For each item of non-compliance, indicate such and provide complete, detailed description of what is proposed in lieu of the specified item / requirement.
   02 Proposed alternatives for items of non-compliance may be accepted or rejected by the Architect; and in the case of rejection, the specified requirements shall be met.

C. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

D. Proof of AWI Quality Certification Program accreditation.

E. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

F. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details, including details of all joinery and assemblies.
   03 Show details of field fabrications, connections and details.
   04 Provide full elevations of all proposed casework. Indicate dimensions, materials and finishes. Indicate all locations to receive filler panels.
   05 Show locations of hardware, service fixtures, trim and other pertinent data for each unit.
   06 Indicate proposed laminate materials (type and thickness) for every surface of the cabinet unit (exposed, semi-exposed, interior and concealed).

G. Sample Cabinet:
   01 Submit typical sample base cabinet (with base) representative of all proposed methods of construction, assembly, joinery and finish.
   02 Sample must include a minimum of one drawer, one door, one interior shelf and removable countertop with attached backsplash.
   03 Sample cabinet does not need to have specific, selected plastic laminate finishes for this project.
   04 Once accepted, the sample cabinet shall be used as the basis to evaluate all casework provided for the project.

H. Samples:
   01 Submit plastic laminate samples (exposed surfaces and liners) of the full range of colors, patterns, textures and finishes from the manufacturer's standard colors, for Architect's selections.
   02 Submit full range of selections available for 3mm PVC edge banding and PVC flat edge banding.
   03 Submit samples of all hardware components proposed to be used.

1.3 DEFINITIONS

A. Identification of casework components and related products by surface visibility.
   01 Exposed Surfaces: Any unit exterior surface exposed after installation (door and drawer faces, face frames, exposed ends, unit tops below 72” AFF, and bottoms of upper cabinets above 60” AFF).
   02 Semi-Exposed Surfaces: Tops of units above 72” AFF, bottoms of upper cabinets below 60” AFF, unit interiors which are visible).
   03 Open Interior Surfaces: Any open unit without solid door or drawer front, units with full glass insert doors and/or acrylic doors, and units with sliding solid doors.
   04 Closed Interior Surfaces: Any visible surface behind solid door or drawer fronts.
   05 Concealed Surfaces: Any surface not visible after installation (unit backs and ends when adjacent to another unit.

1.4 QUALITY ASSURANCE

A. Manufacturer: Minimum of five (5) years of experience in providing manufactured casework systems for similar types of projects, and adequate facilities and personnel required to perform on this project in accordance with the specified requirements.

B. Manufacturer: Provide products certified as meeting or exceeding ANSI-A 161.1-2000 testing standards.

C. Single Source Manufacturer: Casework, countertops and other plastic laminate architectural products must all be engineered and built by a single source manufacturer in order to ensure consistency and quality for these related products.

D. Quality Standard: Unless otherwise indicated or specified, comply with AWI's Architectural Woodwork Quality Standards for grades of interior architectural woodwork, construction, finishes and other requirements.

E. The manufacturer shall be a member of AWI and shall be Quality Certification Program accredited:
   01 Provide AWI Quality Certification Program Certificate indicating that the woodwork complies with requirements of the grade specified.
   02 This project has been registered as AWI/QCP Certification Program project number.
   03 The contractor, upon award of work, shall register the work under this section with the AWI Quality Certification Program.

1.5 WARRANTY

A. Furnish a written warranty that Work performed under this Section shall remain free from defects as to materials and workmanship for a period of three (3) years from date of acceptance. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner.

B. Defects include, but are not limited to:
   01 Ruptured, cracked, or stained coating.
   02 Discoloration or lack of finish integrity.
   03 Cracking or peeling of finish.
   04 De-lamination of components or edge-banding.
   05 Slippage, shift, or failure of attachment to wall, floor, or ceiling.
   06 Weld or structural failure (visible weld marks).
   07 Warping or unloaded deflection of components.
   08 Failure of hardware.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Design of educational casework is based on products as manufactured by TMI Systems Corporation / Texas Distributor: Specialty Supply & Installation Company.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.
   01 Jericho Woodworks
   02 MGC, Inc.
   03 Phoenix Millwork
   04 Steven's Industries

C. Casework of other recognized casework manufacturers may be considered for approval.

01 Casework must conform to design, quality of materials, design intent, workmanship and exact performance function of casework components and details specified and implied by basis of design manufacturer's reference, and as shown on plans regardless of that manufacturer's "product standards".

02 To be considered for acceptance, provide the following:

a. Company data and other information to support acceptance.

b. Evidence that company has been in the primary business of casework manufacturing for a minimum of five (5) years.

c. Return a copy of this Specification with each item / paragraph initialed to signify compliance. Where deviation of any item is proposed, fully described the item proposed.

d. Provide a sample cabinet reflective of what is proposed to be furnished.

D. Plastic Laminate: The following manufacturers are acceptable to provide plastic laminate:

01 Formica

02 Wilson Art

E. Hardware: The following manufacturers are acceptable to provide casework hardware:

01 Doug Mockett & Co.

02 EPCO

03 Julius Blum

04 Knape & Vogt

05 National

06 Stanley

2.2 GENERAL

A. Drawings and Specifications are based upon casework as manufactured by TMI Systems Design, fixed modular casework.

B. Manufacturers requesting approval shall submit evidence of at least five (5) years of experience and installations for similar type of project. Manufacturers shall also provide catalogs and Specifications. Catalogs and Specifications shall be submitted with written request along with detailed list of compliance and deviations from these Documents for approval.

C. In addition to the above requirements, manufacturers requesting approval shall, at the same time, submit certified product test data in accordance with ANSI A161.1-1980, NEMA LD3-2000, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:

01 Base cabinet construction/racking test: 800 lbs.

02 Cabinet front joint loading test: 425 lbs.

03 Wall cabinet static load test: 2,000 lbs.

04 Drawer front joint loading test: 600 lbs.

05 Drawer construction/static load test: 750 lbs.

06 Cabinet adjustable shelf support device/static load test: 300 lbs.

D. The following performance details are project requirements and must be met by all bidders whether named herein, or approved by Addendum, regardless of that manufacturer's "Standards". Deviations will not be allowed.

01 Minimum Quality Standard: comply with AWI's Architectural Woodwork Quality Standards section 400 - Custom Grade for grades of interior architectural casework, woodwork, construction, finishes and other requirements; except as modified by this specification.

02 Cabinet Construction: All core materials shall be of an industrial grade, medium density particle board with non-formaldehyde binders. Board shall exceed performance requirements for ANSI A208.1-1999 M2 Standards.

03 Structural Cabinet Body: Cabinet backs shall be inset from rear of body, and fully bound (dadoed) four sides. Provide 3/4 inch (19.1 mm) thick stiffeners fastened to back/body as specified herein. Back perimeter shall be toe-nailed with mechanical fasteners for tight interior fit and direct connection of back panel to body and sealed with full-perimeter high-strength hot-melt adhesive.

04 Interior Structure: All cabinets over 36 inches (914 mm) wide shall be furnished with a mechanically fastened, yet removable, vertical divider to reduce horizontal member/shelf deflection. Wall cabinets shall have a clear inside nominal depth of 12 inches (305 mm) unless detailed otherwise.

05 Shelf Loading: Shelves shall meet the loading/deflection standards of the National Particleboard Association.

06 Structural Drawer Body: Drawer body shall be doweled with 1/2 inch typical bottom, recessed, fully bound (dadoed) and joint-glued all four sides. Provide under body stiffeners as specified herein.

07 Drawer Suspension: Drawer slides shall be self-closing design, with positive in-stop, out-stop, and out-keeper. Dynamic (operational) load rating shall be minimum 100 lbs. Minimum 150 lbs. static load rating.

08 Structural Cabinet Support: Cabinet sub-base shall be of a separate and continuous ladder-type platform design, leveled and floor mounted prior to cabinet body placement. Material shall be exterior grade plywood. No cabinet sides-to-floor will be allowed.

E. Architect / Owners opinion and decision shall be final in the evaluation of manufacturer's products for approval to bid or award of contract.

2.3 LAMINATE MATERIALS

A. Cabinet High-Pressure Plastic Laminate:

01 High-pressure plastic laminate, .030" nominal in thickness, shall meet NEMA LD3-2000 VGL standards including thickness.

02 Shall be used for all exterior exposed surfaces, including, but not limited to door fronts, drawer fronts, face frames, and cabinet ends.

03 Minimum 0.020" neutral colored backing sheet for balanced construction on all countertop surfaces.

04 Color Selection:

a. Standard finish from casework manufacturer's standard stock colors consisting of wood grain patterns and solid colors. Minimum of 200 selections available.

b. Allow a total of 5 different colors available per project.

c. Direction of wood grain shall be vertical on door, end panels, fascia panels, and exposed backs and ends; horizontal on drawer faces, aprons, and top rails.

B. Countertop High-Pressure Plastic Laminate:

01 High-pressure plastic laminate, .050" nominal thickness. Typical at all countertops and separate backsplashes.

02 High-pressure plastic laminate .042” thickness, post-forming grade. ONLY allowed if post-formed countertops are indicated on the drawings.
03 Minimum 0.020” neutral colored backing sheet for balanced construction on all countertop surfaces.
04 Color Selection:
a. Standard finish from casework manufacturer's standard stock colors consisting of wood grain patterns and solid colors. Minimum of 200 selections available.
b. Allow a total of 5 different colors available per project.

C. Plastic Laminate Balancing Sheet:
01 White high-pressure cabinet-liner, .020” in thickness.
02 Shall meet NEMA LD3-2000 CLS standards.
03 Use at concealed locations and for balancing exterior surface laminates.

D. Pressure Fused Laminate:
01 Melamine resin impregnated, 120 gram PSM minimum, thermo-fused to core under pressure.
02 Shall meet NEMA LD3-2000 VGL standards and NEMA LD3-2000 CLS standards.
03 White pressure fused laminate for cabinet interiors behind door and drawers. Colored pressure fused laminate interiors of all open cabinets, and underside of wall cabinets.
04 Shall be balanced at all concealed surfaces with same weight thermo-fused melamine. Un-surfaced core-board or simple backers are not allowed.

2.4 CORE MATERIALS

A. High Performance Core Material:
01 All countertops, back splash and toe kicks will 7-Ply Birch plywood. All countertops near wet areas, such as sinks or dishwashers…, shall be marine grade 7-ply plywood.
02 All other core materials shall be an Industrial Grade particle board, equal to Ultra-Stock-Premium which shall meet or exceed performance requirements for ANSI A208.1-1999 M2 Standards.
03 All core materials shall be minimum 45 lb. density.
04 All core materials shall have a minimum 250 lb. screw holding capacity on the face plane and minimum 225 lb. screw holding capacity on the edge plane.

B. Cabinet components shall be of the following minimum core thicknesses:
01 1/2 inch (12.7 mm): cabinet backs, drawer body, and drawer bottoms.
02 3/4 inch (19.1 mm): door and drawer face, base, tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hang-strips, structural dividers, exposed cabinet backs, and shelves up to 36” wide.
03 1 inch (25.4 mm): product-specific work surfaces, shelves over 36” wide and library stack shelving unless stack fitted with vertical divider.

C. Marine Grade Plywood:
01 APA Grade A-A, made entirely of Douglas-fir or Western Larch.
02 All inner plies Grade B or better
03 All glues and adhesives shall be waterproof.
04 Material shall comply with Voluntary Product Standard PS1-95 – Construction and Industrial Plywood

2.5 EDGING MATERIALS

A. Edging types. Provide one or more of the following in accordance with "Edging Locations":
   01 3 mm thick PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, automatically trimmed, inside/outside length-radiused for uniform appearance, buffed and corner-radiused for consistent design.
   02 Flat Edge PVC: .020 inch (.51 mm). Solid, high-impact, purified, color-thru, acid resistant PVC edging, machine-applied with hot melt adhesives, automatically trimmed face, back and corners for uniform appearance. Manufacturer's option of .030 inch (.76 mm) high-pressure plastic laminate if matching PVC is unavailable.

B. Edging Locations. Provide the above specified edging types at the following locations, of the following colors:
   01 Door/Drawer-Front edging: 3mm PVC selected from a minimum of 30 standard colors, color matched to standard laminates.
   02 Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door / drawer face or as selected.
   03 Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.

2.6 DETAILED REQUIREMENTS FOR CABINET CONSTRUCTION:

A. Base Cabinet Sub-Base:
   01 All base cabinets shall be mounted on sleeper sub-base assemblies completely separate from the cabinet body.
   02 Vertical cabinet body components extending to the floor shall not be accepted.
   03 Cabinet sub-base shall be continuous and separate from base cabinets. Individual sub-bases attached to each base cabinet box shall not be accepted.
   04 Sub-base assemblies shall be fabricated from minimum 1-1/2” thick components, using one or more of the following materials / assemblies:
      a. CCA / QCA treated 2x SYP materials.
      b. CCA / QCA treated 1x SYP materials.
      c. Marine grade plywood.
   05 Sub-base shall be ladder-type construction of individual front, back, ends and intermediates, to form a secure and level platform to which base cabinets attach.
      a. The front of sub-base shall be a single continuous member wherever possible; and where not possible due to the length of the base cabinet bank, shall have joints at not less than 96” apart.
   06 Provide plastic shims as required to level the sub-base along its entire length.
   07 Sub-bases at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, facilitating flush installation of finished base material by other trades.

B. Cabinet Top and Bottom:
   01 Solid sub-top shall be furnished for all base and tall cabinets.
   02 At cabinets over 36 inches, bottoms and tops shall be mechanically joined by a fixed divider.

03 Exposed wall cabinet bottoms shall be Pressure Fused white laminate. Assembly devices shall be concealed on bottom side of wall cabinets.

C. Cabinet Ends:
01 Exposed exterior cabinet ends shall be laminated with high-pressure plastic laminate, balanced with high-pressure cabinet-liner interior surface.
02 Holes drilled for adjustable shelves shall be 1-1/4” on center to within 6” of top and bottom of cabinet.

D. Cabinet Backs:
01 Cabinet back shall be fully bound (dadoed) into sides, top frame, and bottom, recessed 7/8 inch from cabinet rear.
02 Back shall be secured to cabinet body with mechanical fasteners and solidified with a continuous bead of industrial grade hot melt adhesive.
03 Hang rails shall be located at rear of cabinet back and fastened to cabinet sides.
a. Provide minimum of 2 at base cabinets, 2 at upper wall-hung cabinets, and 3 at tall cabinets.
04 Exposed exterior backs shall be high-pressure plastic laminate balanced with high-pressure cabinet-liner.

E. Door and Drawer Fronts:
01 Drawer fronts and hinged doors shall overlay the cabinet body.
a. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
02 Laminated door and drawer fronts shall be 13/16 inch thick to provide a flush / on-plane appearance.
03 Stile and rail doors shall be 13/16 inch thick with full 1/4 inch plate glass.
a. To be hinged or sliding as indicated on the Drawings.
b. All exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
04 Frameless sliding glass doors shall be 1/4 inch thick clear, laminated safety glass with ground and polished edges. See Paragraph 2.8 HARDWARE for frame and rollers.

F. Drawers:
01 Drawer fronts shall be applied to separate drawer body component sub-front.
02 Drawer sides shall be doweled and glued to receive front and back, machine squared and held under pressure through final set.
03 Drawer bottom shall be fully bound (dadoed) into front, sides, and back. Routing, in drawer body for bottom, shall receive continuous glue.
04 Reinforce drawer bottoms with 1/2 inch x 4 inch intermediate underbody stiffeners, mechanically fastened, run front to back.
a. Drawers less than 24” wide do not require stiffeners.
b. Provide one stiffener at drawers 24” to 35” wide.
c. Provide two stiffeners at drawers 36” to 48”.
05 Drawers to be used for flat paper storage shall be fitted with a 6” deep, full width hood at back of drawer.

G. Fixed and Adjustable Shelves:
01 Thickness shall be 3/4" for units up to 36” wide.
02 Thickness shall be 1” for units wider than 36”.

H. Vertical and Horizontal Dividers: One of the following as indicated on the Drawings or by cabinet number:
   01 Natural hardboard 1/4" thick, smooth both faces. Secure in cabinet with molded plastic clips.
   02 Plastic laminate clad, 1/2" or 3/4" thick core material. Sub-dividers shall be secured in cabinet with molded plastic clips or dowels.
   03 Structural dividers in cabinets over 36” wide shall be secured in cabinet with mechanical euro fasteners.

I. Door / Drawer Front Rail: Provide minimum 3/4" x 6” x full width cabinet body rails immediately behind all door/drawer and multiple drawer horizontal joints to maintain exact body dimensions, close off reveal, and be locator for lock strikes.

J. Countertops:
   01 High-pressure plastic laminate bonded to core.
   02 All countertops, back splash and toe kick shall be 7 ply birch plywood.
   03 All countertops within 36” of a sink, shall be marine grade veneer plywood.
   04 Core thickness: 1-1/4”. Underside shall be fully balanced with minimum 0.020” backing sheet.
   05 Furnish countertops with edge treatment, backsplash and design profile as shown on Drawings. countertops to get PVC edging.
   06 Provide tops in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
   07 Mobile cabinet tops shall be high-pressure plastic laminate on exterior and high-pressure cabinet-liner on underside. Edges shall be high-impact 3 mm PVC.

K. Workmanship:
   01 All exposed exterior cabinet surfaces shall be .030 inch high-pressure laminate, color as selected from casework manufacturer's standards, over 200 colors/wood grains available. Laminate surface/balancing liner to core under controlled conditions by approved and regulated laminating methods to assure a premium lamination. Natural-setting hybrid P.V.A. Type III water resistant adhesives that cure through chemical reaction, containing no health or environmentally hazardous ingredients, are required. Methods requiring heat are not allowed; "contact" methods of laminating are not allowed.
   02 Cabinet parts shall be accurately machined and bored for premium grade quality joinery construction utilizing automatic machinery to insure consistent sizing of modular components. End panels shall be doweled to receive bottom and top.
   03 Back panel shall be fully bound (dadoed) into, and recessed 7/8 inch from the back of cabinet sides, top, and bottom to insure rigidity and a fully closed cabinet. Cabinet back shall be mechanically fastened from rear of body for tight interior fit and sealed with full-perimeter high-strength hot-melt adhesive.
   04 Drawer bottom shall be fully bound (dadoed) and glued into and recessed 1/2 inch up from the bottom of sides, back, and sub-front. Sides of drawer shall be doweled to receive drawer back and sub-front.
   05 3/4 inch thick hang rails shall be mechanically fastened to end panels of all wall, base, and tall cabinets for extra rigidity and to facilitate installation.
   06 All cases shall be square, plumb, and true.

07 Case body and drawer workmanship and quality of construction shall be further evidenced by Independent Testing Laboratory results.

08 Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.

L. ADA, 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:

01 Countertop height: With or without cabinet below, not to exceed a height of 34 inches A.F.F. (Above Finished Floor) at a surface depth of 24 inches.

02 Knee Space Clearance: Provide a minimum of 29 inches A.F.F. at apron, and 30 inches clear span width.

03 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.

04 Wardrobe cabinets: Shall be furnished with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.

05 Sink cabinet clearances: In addition to above, upper knee space 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.

2.7 HARDWARE

A. Hinges: Heavy duty, five-knuckle, 2-3/4” institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Design is based on Stanley Hardware No. 351490, class 1592 Interleaf Casework Hinge, or approved equal.

01 Mill ground, hospital tip.

02 Hinge shall be full wrap around type of .088” thick tempered steel.

03 Each hinge shall adjustable in both vertical and lateral directions to assure positive door attachment and alignment.

04 Provide one pair per doors up to 48-inch height; and one and one-half pair on doors over 48” in height.

05 Hinge shall accommodate 13/16” thick laminated door and allow 270 degree swing.

06 Finish shall be 26D satin chromium plated finish.

B. Pulls: Wire design, solid brass, 4” x 1-5/16” projection. Design is based on EPCO MC402-4-BRC; or approved equal.

01 Finish shall be 26D satin chromium plated finish.

C. Locks:

01 Pin tumbler, cam type locksets, allowing removal of key when lock is in unlocked position.

a. Design is based on C415A series; or approved equal.

b. Do NOT leave ANY keys in the cabinets. Do not give any keys to staff. All keys are to be delivered to the Diretor of Facilities.

02 Locks keyed alike in individual rooms and master keyed as directed by the Architect / Owner. Provide catches on non-active leafs on door pairs.

03 Finish shall be 26D satin chromium plated finish or dull chrome finish.

04 Provide cabinet locks on units as indicated on the Drawings. If not indicated on the Drawings, provide locks for 50% of the doors and drawers. Coordinate locations with Architect.

D. Standard Drawer Slides:

01 Standard Drawers: Full extension, telescopic, self-closing design, steel ball bearing operation with positive in-stop, out-stop. Design is based on Knape & Vogt # 8417; or approved equal.
02 Minimum 100 lb. dynamic load rating. Electro-zinc plated with lacquer top coat.

E. File Drawer Slides:
01 File Drawers: Full extension, 3-part progressive opening slide on precision steel ball bearings; minimum 100 lb. dynamic load rating; hold-in feature to prevent bounce-back; positive in / out stops. Design is based on Knape & Vogt # 8500; or approved equal.
02 Provide integral, body mounted molded steel rails for hanging file system for legal and letter file drawers. Cutting or machining of drawer body / face is not allowed.
03 Provide electro-zinc plated with lacquer top coat.

F. Catches: Catch shall provide opening resistance in compliance with the Americans with Disabilities Act.
01 Non-Locking Doors: Provide top-mounted magnetic catch for base and wall cabinet doors. Provide two at each tall cabinet door. Design is based on EPCO no. 592; or approved equal.
02 Locking Pair of Doors: Furnish an elbow catch on the door leaf not receiving a lock. One required on doors up to 48 inches tall and two required (top and bottom) on doors over 48 inches tall. Design is based on EPCO no. 1018; or approved equal.

G. Adjustable Shelf Supports: Twin pin design with anti-tip-up shelf restraints for both 3/4" and 1” shelves.
01 Design shall include keel to retard shelf slide-off, and slot for ability to mechanically attach shelf to clip.
02 Load rating shall be minimum 300 lbs. each support without failure.
03 Cabinet interior sides shall be flush, without shelf system permanent projection.

H. Sliding Glass Door Hardware:
01 Framed Assembly Sliding Doors: Design based on EPCO Assembly 16 (modified to #730 head / jamb track), complete for the intended installation; or approved equal.
02 Provide continuous top and jamb tracks, continuous glazing shoes, track base with double track, and rollers.
03 Provide sliding Glass Door Lock: Ratchet type lock. Design is based on EPCO G05 series locks; or approved equal.

I. Wardrobe Rod: Shall be 1-1/16” rod, supported by flanges both sides, chrome finish; or equal.

J. Coat Hooks:
01 Single prong coat hooks, ceiling mount. Satin finish.
02 Double prong coat hooks, ceiling mount. Satin finish.

K. Grommet:
01 Design is based Doug Mockett & Co. Model “XG”, 3” diameter, round grommet with flip top series; or approved equal.
02 Provide one (1) grommet at each non-plumbing knee space with power and data below countertop.

2.8 SPECIAL MATERIALS

A. Cabinet Bases / Sleepers:
   01 All base cabinets shall be mounted on sleeper assemblies completely separate from the cabinet body.
   02 Base cabinet bodies shall not extend to the floor.
   03 Base assemblies shall be fabricated using treated plywood materials.
   04 Provide 3/4" non-treated material at toe recess for installation of specified base materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Carefully inspect all casework upon delivery. All units damaged upon arrival shall be returned to the manufacturer for repair and / or replacement.

B. Any / all units which do not have required balance sheets on concealed surfaces shall be returned to the manufacturer for repair and / or replacement. Field application of balance sheets shall not be allowed.

C. Leave protective shipping materials in place until casework is delivered to its final room destination. Use all means necessary to protect adjacent work during transit and installation in the building.

3.2 PREPARATION

A. Coordinate with other trades as required for proper installation of blocking in walls, etc. for secure attachment of casework. Verify exact field installed locations.

B. Inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence. Closely inspect the squareness and flatness of walls behind cabinets to facilitate a tight, even fit of casework to wall. Coordinate with other trades as required for corrective prep work.

C. Inspect conditions at floor slabs for proper installation of cabinet sub-bases. Coordinate with other trades as required for corrective prep work.

D. Verify rough plumbing and electrical work is properly located to permit casework, fixtures and equipment to be installed in strict accordance with the original design, pertinent codes, and regulations, and reviewed Shop Drawings.

E. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until such discrepancies have been resolved.

3.3 INSTALLATION

A. Casework base cabinet components / boxes shall be assembled in the configurations and locations as indicated on the Drawings.
   01 Securely anchor base cabinets to sub-base and through back to wall blocking at top of casework.
   02 Securely fasten casework base cabinets through sides to adjacent base cabinet(s).

03 In as much as practical, standardize fastener locations at each cabinet to maintain a uniform appearance.

B. Casework upper wall cabinet components / boxes shall be assembled in the configurations and locations as indicated on the Drawings.
01 Wall cabinets shall align with base cabinets unless specifically shown otherwise on the Drawings.
02 Securely anchor upper wall cabinets through back to wall blocking at top and bottom of each cabinet.
03 Securely fasten casework upper wall cabinets through sides to adjacent upper wall cabinet(s).
04 In as much as practical, standardize fastener locations at each cabinet to maintain a uniform appearance.

C. Provide matching fillers and scribes to fit cabinets to partitions, columns and other adjacent interfacing work. At wall-to-wall conditions, center cabinets for equal fillers / scribes each end.

D. Provide closure panels at top and bottom of upper wall cabinets at blind corner and similar locations.

E. Verify lengths of countertops, splashes, and sub-bases. Provide in longest practical lengths to minimize splices in plastic laminate. Securely fasten countertop to each base cabinet from the underside through the top of the base cabinet.

F. Provide back-splashes and end-splashes wherever a back or end is adjacent to a wall, whether shown or not.

G. Plumbing and electrical items shall be furnished under the Plumbing and Electrical Section.
01 Installation of work furnished by the various trades shall be coordinated to assure properly functioning equipment at the completion of the job.
02 The casework supplier shall be responsible for all cutouts necessary to receive plumbing items. Provide ‘J’ clamps to secure sinks to countertops.

H. Seal all joints in countertops, splashes and walls continuous with clear acrylic sealant.

3.4 ADJUSTMENT

A. Doors:
01 Upon completion, adjust all doors / hinges to be hung plumb and square, resulting in a consistent gap between pairs of doors at +/- 1/8”.
02 Verify that magnetic catches and latches are positioned correctly to hold door in tight, fixed position. Adjust as required.

B. Drawers:
01 Upon completion, adjust all drawers to function easily and smoothly, without binding or shimmying.
02 Verify that drawers with automatic closing hardware function properly.

C. Locks:
01 Verify all proposed locations with Architect prior to commencement.

02 Verify locks in each room / area are keyed in accordance with the Owner's standards and direction.

03 Install locks in cabinets as indicated on the Drawings or directed by the Architect.

04 Provide stops, catches and similar hardware, properly placed to provide positive locking.

05 Using cabinet body and similar components as stops / catches is prohibited.

D. Final Cleaning: Upon completion of all final adjustments, thoroughly clean all debris from cabinets; including, but not limited to: glue, sealant, pencil marks, saw-dust, wood shavings, loose hardware, smudges, dirt and other similar items.

END OF SECTION

SECTION 13 34 16.16

ALUMINUM BLEACHERS, TEAM BENCHES, AND PRESS BOXES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Elevated angle frame bleachers
   02 Team benches
   03 Pre-manufactured press box

C. Related Work:
   01 Section 02 32 00 – Geotechnical Report
   02 Section 32 13 13 – Concrete Paving and Flatwork
   03 Section 32 31 31 – Chain Link Fences & Gates

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop Drawings shall be sealed and signed by a Texas Registered Engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

G. Submit structural design calculations by a professional engineer registered in the state where the project is located.

H. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 DESIGN REQUIREMENTS – PRESS BOX

A. Design Code: Structural design for the building structural system shall be provided by the press box manufacturer for the following design criteria:
   01 International Building Code (IBC) 2021
   02 Occupancy Category: Group U

B. Design Loads:
   01 Dead Load – Weight of the building system as determined by manufacturer.
   02 Roof Live Load – Per the building code referenced in paragraph 1.3A.
   03 Collateral Load – Per the building code referenced in paragraph 1.3A.
   04 Wind Load:
      a. Exposure: C.
      b. Risk Category: II
      c. Wind Speed: 126 MPH, 3 second gusts.
   05 Seismic Load: NA
   06 Auxiliary Loads: Auxiliary loads shall include dynamic loads, such as cranes and material handling systems, and will be defined in the Contract Documents.

C. Roof canopies and roof extensions shall be designed for an uplift wind load of twice the basic wind pressure required for the building.

D. In the design of the wall components, the design wind pressure acting inward shall be per the building code referenced in paragraph 1.3A.

1.4 WARRANTY

A. Provide minimum five (5) year parts and labor warranty to cover defects in material and/or workmanship.
   01 Warranty to start at date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Southern Bleacher Company

B. Sturdisteel Grandstands & Press Boxes (Basis of Design)

2.2 MATERIALS - BLEACHERS

A. Galvanized Steel: Structural fabrication with ASTM A529 steel. Shop connections are seal welded. After fabrication, all steel to be hot-dipped galvanized to ASTM A123 specification.

B. Extruded Aluminum:
   01 Seat Planks, Riser Planks, Step Risers: Extruded aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II, with a wall thickness of 0.094".
   02 Tread Planks: Extruded aluminum 6063-T6 alloy, mill finish with a wall thickness 0.094 inch.

C. Accessories:
   01 Channel End Caps: Aluminum alloy 6063-T6,clear anodized 204R1, AA-M10C22A31, Class II.
   02 Hardware:
      a. Bolts, Nuts: Galvanized or plated.
      b. Hold down Clip Assembly: Aluminum alloy 6061-T6.
   03 Guardrailing: Anodized aluminum rail 1-5/8" O.D. with galvanized chain link.
   04 Crossbraces: Extruded aluminum angle alloy 6061-T6, mill finish.
   05 Aisle Nose: Aluminum alloy, 6063-T6, black powder-coat finish.

D. Mudsills: All stands shall have 2" x 6" treated mudsills at every point where steel would otherwise be in contact with concrete, drilled for field bolting. Cut mudsill as required for drainage. Drainage cuts to be located 4 feet from front of bleachers and 4 feet from back of bleachers. Cuts to be approximately 12 inches wide. Where mudsills intersect inlet location(s), provide drainage cut, sized so that inlet cover can be removed for maintenance.

2.3 DESIGN CRITERIA - BLEACHERS

A. Design Loads:
   01 Live Load: 100 psf gross horizontal projection.
   02 Lateral Say Load: 24 lbs. lin. ft. seat plank.
   03 Perpendicular Sway Load: 10 lbs. lin. ft. seat plank.
   04 Wind Load: 30 psf vertical projection.
   05 Live load of Seat and Tread Plank: 120 lbs. lin. ft.
   06 Guardrailings shall be capable of resisting 50 lb/lin. ft. horizontal load and 100 lb./lin. ft. vertical load applied to top rail without causing permanent deformation.
   NOTE: Support frame work shall not exceed 6'-0" on centers and be connected by crossbracing.

B. Contractor shall provide concrete foundations and/or paving below all bleachers as directed by bleacher manufacturer.

2.4 COMPETITION SOCCER FIELD BLEACHERS

A. Angle Frame Bleachers:
   01 Provide one (1) unit, five (5) rows each, fixed-type as manufactured by Sturdisteel Grandstands & Press Boxes.
      a. Two (2) 2 x 10 aluminum mill finish footboards, standard “semi-closed” deck bleacher system.
      b. Aluminum 2 x 10 clear anodized seats.
      c. Aluminum clear anodized risers at each row.
      d. Galvanized steel angle frame understructure, with galvanized steel cross-bracing and guardrail posts.
      e. Minimum one (1) ADA ramp and one (1) exit stair with handrails.
      f. Two (2) line aluminum pipe rail system with 9-gauge chain link fence infill guardrail.
      g. Aisles to have midrails as required by code.
   02 Vertical rise per row - 8".
   03 Horizontal depth per row - 24".
   04 Height of seats above footrest - 17".
   05 Height of bleacher above adjacent grade: 48 inches or as required to access adjacent press box.
   06 Length of stand – as required to accommodate 200 people minimum, not including accessible seating (approximately 90’-0” long).
   07 Accessible seating area(s) meeting ADA and local codes.
   08 Separate dissimilar metals as required.

2.5 TEAM BENCHES:

A. Provide two (2) team bench units with backrest.
   01 Team Bench as manufactured by Sturdisteel Grandstands & Press Boxes.
   02 Length: 24 feet minimum
   03 In-ground mount
   04 Material:
      a. Galvanized steel frame and hardware
      b. 10” anodized aluminum seats.
      c. Anodized aluminum backrest
   05 Finish: Clear anodized
   06 Separate dissimilar metals as required.

2.6 PRESS BOX:

A. Metal press box as manufactured by Sturdisteel Grandstands & Press Boxes.
   01 8’-0” X 12’-0” press box with 8’-0” x 18’-0” support system.
   02 Metal siding with metal framing, pre-manufactured with lights, vinyl framed vertical sliding windows and electrical outlets.
      a. Exterior 26-gauge type R metal panels
      b. Non-combustible steel framing
      c. 5/8” CD Exterior Grade plywood
      d. 2’ x 2’ acoustical tile ceiling
   03 One (1) interior room with interior door access.
   04 One (1) 6’-0” landing with access to top of bleacher system.
   05 Galvanized steel independent I-beam support structure with galvanized steel angle cross bracing on all four (4) sides of support structure.

06 Aluminum interlocking deck floor, vinyl coated gypsum walls, laminate counter top along the front wall in each room.
07 One (1) through wall HVAC with thermostat (model: Friedrich KES12A33A).
08 Interior exit lights and exterior lights at the door.
09 Press Box manufacturer is responsible for concrete foundation design based on site specific Geotechnical report (reference **section 02 32 00 – Geotechnical Report**). Foundation to be installed by others. General Contractor to coordinate.
10 Electrical hook-ups to be done by a licensed electrician (electrical provided by others). General Contractor to coordinate.
11 Architect to select colors and finishes from manufacturer's standard colors.
12 Contractor shall provide concrete foundations and/or paving below press box as directed by press box manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION - BLEACHERS

A. Install bleacher units on concrete slab as shown.

B. Anchor framing to slab on 2x6 treated continuous wood mudsills and shim as required for proper rigid support.

C. Perform work of this Section with competent mechanics skilled in bleacher work and under the direct control and supervision of bleacher manufacturer's representative.

D. Install bleachers in strict accordance with approved shop drawings and details.

E. Where erection is complete, the portion of site shall be cleared and bleachers and cleaned of all scrap and trash.

F. Install chain link fence along front, rear and sides of bleachers to prevent unwanted access to underside of bleachers. Provide two (2) 3-foot wide gates at back side of bleachers for access. Gates to be at locations shown on drawings. If not shown on drawings, gates shall be located by Architect in the field.

3.2 INSTALLATION – PRESS BOX

A. Install press box in strict accordance with approved shop drawings and details.

B. Coordinate with bleachers to ensure proper alignment of steps with landing.

C. Install chain link fence along all exposed sides of press box to prevent unwanted access to underside of press box. Provide one (1) pair of 3-foot wide gates at back side of press box for access. Gates to be at locations shown on drawings. If not shown on drawings, gates shall be located by Architect in the field.

END OF SECTION

SECTION 13 34 19

METAL BUILDING SYSTEMS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work: Work under this section of the specifications shall include all labor, materials, equipment and appurtenances for the installation of complete pre-engineered building(s) as indicated on the Drawings and herein specified.
   01 To include all structural components and parts of the building, including, but not limited to primary structural steel framing, purlins, girts, necessary bracing, struts, wall and roof openings, and connecting members.
   02 To include all roof and wall panels, flashing curbs, gutters and downspouts, integrated insulation, all with necessary closures and fasteners.
   03 Coordination of this Section of the Specifications with all other trades is mandatory, so that all phases of work will be properly coordinated and interfaced with the metal building systems.
   04 Interfacing work that may be provided by others includes, but is not limited to doors and frames, overhead doors, louvers, roof-top equipment, fireproofing, masonry, roof and wall insulation, and mechanical, electrical and plumbing work. Coordinate as required.

C. Related Work:
   01 Section 07 21 00 – Thermal Insulation
   02 Section 07 41 13 – Metal Roof Panels
   03 Section 07 42 13 – Metal Wall Panels
   04 Section 07 62 00 – Sheet Metal Flashing
   05 Section 08 11 13 – Hollow Metal Doors and Frames
   06 Section 08 33 23 – Overhead Coiling Doors
   07 Section 08 71 00 – Door Hardware
   08 Section 08 90 00 – Louvers and Vents
   09 Section 10 73 26 – Aluminum Walkway Coverings

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer’s literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop Drawings shall be sealed and signed by a Texas Registered Engineer.

D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

E. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

F. Color / Finish Samples:
   01 Provide two (2) samples of each finish for selection by the Architect.
   02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
   03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. ASTM International:
   01 ASTM A 36 – Standard Specification for Carbon Structural Steel.
   02 ASTM A 48 – Specification for Gray Iron Castings.
   03 ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   04 ASTM A 307 – Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength.
   05 ASTM A 325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength.
   06 ASTM A 354 – Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
   07 ASTM A 475 – Specification for Zinc-Coated Steel Wire Strand.
   08 ASTM A 490 – Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 KSI Minimum Tensile Strength.
   09 ASTM A 500 – Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   10 ASTM A 529 – Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
   11 ASTM A 563 – Specification for Carbon and Alloy Steel Nuts.

12 ASTM A 572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
13 ASTM A 653 / A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
14 ASTM A 792 / A 792M – Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
15 ASTM A 992 – Standard Specification for Structural Steel Shapes.
16 ASTM A 1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
17 ASTM A 1039 – Specification for Steel, Sheet, Hot Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, Produced by Twin-Roll Casting Process.
18 ASTM E 96 / E 96M – Standard Test Methods for Water Vapor Transmission of Materials.
19 ASTM E 108—Spread-of Flame Testing: Class 1A Rating.
20 ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
21 ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
22 ASTM E 1592 – Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
23 ASTM E 1646 – Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
24 ASTM E 1680 – Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
25 ASTM E 2140 – Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head.
26 ASTM F 436 – Specification for Hardened Steel Washers.
27 ASTM F 1145 – Specification for Turnbuckles, Swaged, Welded, Forged.
28 ASTM F 1554 – Specification for Anchor Bolts, Steel, 36, 55, and 105-KSI Yield Strength.

B. American Institute of Steel Construction (AISC):
01 AISC Specification for Structural Steel Buildings.
02 AISC Serviceability Design Considerations for Low-Rise Buildings.

C. American Iron and Steel Institute (AISI):
01 AISI North American Specification for the Design of Cold-Formed Steel Structural Members.

D. American Welding Society (AWS):
01 AWS D1.1 / D1.1M – Structural Welding Code – Steel.
02 AWS D1.3 / D1.3M – Structural Welding Code – Sheet Steel.

E. Association for Iron & Steel Technology (AISE):
01 AISE 13 – Specifications for Design and Construction of Mill Buildings.

F. Metal Building Manufacturers Association (MBMA):
01 MBMA Metal Building Systems Manual.

1.4 DESIGN - GENERAL

A. The building design incorporates the general design parameters of the metal building as it relates to the building architecture. These parameters include:
   01 Centerline of rigid frames.
   02 Locations of endwall columns.
   03 Eave height(s).
   04 Cantilever and supported overhangs.
   05 Wind bracing.
   06 Opening types, sizes and locations.

B. Reasonable considerations have been incorporated in the building design to allow for the design of the metal building by the manufacturer to conform to, adapt to and fit within the building architecture as indicated on the Drawings.

C. Special areas of consideration include wind frames / bents, bridging, angle bracing and rod bracing.

D. Deviations in the architecture of the building, as shown, in order to accommodate the metal building system design shall not be considered.
   01 The manufacturer shall design the building as required to conform to, adapt to and fit within the building architecture as indicated on the Drawings.

E. The general building design as indicated on the Drawings is based on the use of 8-inch roof purlins, eave struts and wall girts.
   01 The metal building design shall incorporate 8-inch members, increasing the gauge of the member(s) where required to meet design loads.

F. The metal building design shall accommodate collateral loads that are suspended from the roof structure. The minimum collateral loads shall be based on 3 PSF; however, review the Drawings as required to account for actual collateral loads imposed by other trades.

1.5 BUILDING NOMENCLATURE

A. Metal Building System: A building system that will employ the following as indicated on the Drawings:
   01 Either continuous or simple-span ‘Z’ or ‘C’-shaped cold-formed purlins or open-web steel joists for support of the roof cladding.
   02 Simple-span ‘Z’ or ‘C’-shaped cold-formed purlins or open-web steel joists for support of the steel wall cladding.
   03 Three-plate, built-up rigid space frames and/or cold-formed ‘C’ or hot-rolled I-shaped post-and-beam framing to support the roof and wall secondary members.
   04 All systems (cladding, roof and wall secondary, lateral primary framing, and longitudinal bracing) work together to provide resistance to vertical and lateral loading demands.

B. Gable Symmetrical: A continuous frame building with the ridge in the center of the building, consisting of tapered or straight columns and tapered or straight rafters.
   01 The sidewall girts may be continuous (by-passing the columns) or simple span (inset in the column line).
   02 The rafters may or may not have interior columns.

C. Gable Asymmetrical: A continuous frame building with an off-center ridge, consisting of tapered or straight columns and tapered or straight rafters.
   01 The eave height and roof slope may differ on each side of the ridge.
   02 The sidewall girts may be continuous (by-passing the columns) or simple span (flush in the column line). The rafters may or may not have interior columns.

D. Single-Slope: A continuous frame building which does not contain a ridge but consists of one continuous slope from side to side.
   01 The building consists of straight or tapered columns and tapered or straight rafters.
   02 The sidewall girts may be continuous (by-passing the columns) or simple span (flush in the column line).
   03 The rafters may or may not have interior columns.

E. Lean-To (LTO): A building extension, which does not contain a ridge, but consists of one continuous slope from side to side. These units usually have the same roof slope and girt design as the building to which they are attached and supported by.

F. Roof Slope: Pitch expressed as inches of rise for each 12" of horizontal run.

G. Building Width: Measured from outside to outside of sidewall secondary structural member (girt).

H. Building Eave Height: A nominal dimension measured from the finished floor to top flange of eave strut.

I. Building Length: Measured from outside to outside of endwall secondary structural member.

J. Auxiliary Loads: Dynamic loads induced by cranes, conveyors, or other material handling systems.

K. Collateral Loads: The weight of any non-moving equipment or material, such as ceilings, electrical or mechanical equipment, sprinkler systems, plumbing, or ceilings.

L. Dead Load: The actual weight of the building system (as provided by the metal building supplier) supported by a given member.

M. Floor Live Loads: Loads induced on a floor system by occupants of a building and their furniture, equipment, etc.

N. Roof Live Loads: Loads produced by maintenance activities, rain, erection activities, and other movable or moving loads but not including wind, snow, seismic, crane, or dead loads.

O. Roof Snow Loads: Gravity load induced by the weight of snow or ice on the roof, assumed to act on the horizontal projection of the roof.

P. Seismic Loads: Loads acting in any direction on a structural system due to the action of an earthquake.

Q. Wind Loads: The loads on a structure induced by the forces of wind blowing from any horizontal direction acting on all vertical, horizontal and sloped surfaces of the building.

1.6 DESIGN REQUIREMENTS

A. General:
- 01 The building manufacturer will use standards, specifications, recommendations, findings and/or interpretations of professionally-recognized groups such as AISC, AISI, AWS, ASTM, CSA, CWB, MBMA, Federal Specifications, and unpublished research by MBMA as the basis for establishing design, drafting, fabrication, and quality criteria, practices, and tolerances.
- 02 The Manufacturer's design, drafting, fabrication and quality criteria, practices, and tolerances shall govern, unless specifically countermanded by the Contract Documents.
- 03 Design structural mill sections and built-up plate sections in accordance with code-appropriate edition of AISC's "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", ANSI/AISC 360 ASD method.
- 04 Cold-Formed steel structural members and panels will generally be designed in accordance with "Specifications for the Design of Cold-Formed Steel Structural Members", 2007 Edition, ANSI/AISI S-100-07.
- 05 Design weldments per the following:
  - a. Structural Welding: Design per AWS D1.1, “Structural Welding Code – Steel”, Latest Edition.
  - b. Cold-Formed Welding: Design per AWS D1.3, “Structural Welding Code – Sheet Steel”, Latest Edition.

B. Design Code: Structural design for the building structural system shall be provided by the metal building system manufacturer for the following design criteria:
- 01 International Building Code (IBC) 2021
- 02 Occupancy Category: Group U

C. Design Loads:
- 01 Dead Load – Weight of the building system as determined by manufacturer.
- 02 Roof Live Load – Per the building code referenced in paragraph 1.6B.
- 03 Collateral Load – Per the building code referenced in paragraph 1.6B.
- 04 Wind Load:
  - a. Exposure: C.
  - b. Risk Category: II
  - c. Wind Speed: 126 MPH, 3 second gusts.
- 05 Seismic Load: NA
- 06 Auxiliary Loads: Auxiliary loads shall include dynamic loads, such as cranes and material handling systems, and will be defined in the Contract Documents.

D. Roof canopies and roof extensions shall be designed for an uplift wind load of twice the basic wind pressure required for the building.

E. In the design of the wall components, including girts and wall panels, the design wind pressure acting inward shall be per the building code referenced in paragraph 1.6B.

PART 2 - PRODUCTS

2.1 PRE-ENGINEERED BUILDING MANUFACTURERS

A. Design of metal building systems is based on Nucor Building Systems.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements.

01 Alliance Steel Buildings
02 American Steel Building
03 Athens Steel Buildings
04 Butler Manufacturing Company
05 Kirby Building Systems
06 Metallic Building Company
07 Mid-West Building Company
08 Red Dot Building Systems
09 Schulte Building Systems
10 USA Steel
11 Varco Pruden
12 Whirlwind Steel Building Company

2.2 MATERIALAS – GENERAL

A. General:

01 All framing members shall be shop-fabricated for bolted field assembly.

02 Primary structural framing shall include the sloping rafters and columns (rigid frames), endwall columns, and wind bracing.

03 Secondary structural framing shall include the purlins, girts, eave struts, flange bracing, sill support, slips, and other miscellaneous structural parts.

04 Unless otherwise specified, the minimum thickness of framing members shall be as follows:

a.	Cold-formed secondary framing members	16 gauge
b.	Webs of welded built-up members	1/4"
c.	Flanges of welded built-up members	1/4"
d.	Bracing rods	1/2" diameter

05 Cold-formed sections shall be manufactured by precision roll or brake forming. All dimensions shall be true, and the formed member shall be free of fluting, buckling or waviness.

06 All shop connections shall be by welding in accordance with the AWS Structural Welding Code D1.1-72. Welders and welding operators shall have been previously qualified as provided in the code. All flange to web welds shall be continuous submerged or the shielded arc process. Butt welds in flange and web plates shall be full penetration.

07 All field connections shall be field bolted with ASTM A325 (.0003 Bronze Zinc Plated) as shown on the Drawings. A325 bolts shall be tightened / torque as stipulated by the Registered Engineer responsible for the design.

08 Where required, connections in secondary members shall be made with special 1/2" oval head, with hex nuts. The faying surfaces of all bolted connections shall be smooth and free from burrs or distortions.

09 All framing members shall carry an easily visible identifying mark, either stamped, stenciled or painted.

B. Primary Framing Steel:
01 Steel for hot rolled shapes must conform to the requirements of ASTM Specifications A-36, A-572 or A-992, with minimum yield of 36 or 50 KSI, respectively.
02 Steel for built-up sections must conform to the requirements of ASTM A-1011, A-1018, A-529, A-572 or A-36 as applicable, with minimum yield of 42, 46, 50, or 55 KSI as indicated by the design requirements.
03 Round Tube must conform to the requirements of ASTM A-500 Grade B with minimum yield strength of 42 KSI.
04 Square and Rectangular Tube must conform to the requirements of ASTM A-500 Grade B with a minimum yield strength of 46 KSI.
05 Steel for Cold-Formed Endwall "C" sections must conform to the requirements of ASTM A-1011 or A-1039 Grade 55, or ASTM A-653 Grade 55 with minimum yield strength of 55 KSI.
06 X-bracing will conform to ASTM A-36 or ASTM A-529 for rod and angle bracing or ASTM A-475 for cable bracing.

C. Secondary Framing Steel:
01 Steel used to form purlins, girts and eave struts must meet the requirements of ASTM A-1011 or ASTM A-1039 Grade 55 for primed material or ASTM A-653 Grade 55 for galvanized material with a minimum yield of 55 KSI.
02 Design Thicknesses – Gauge to be determined by design to meet specified loading conditions.

D. All primary and secondary steel framing that is exposed to the exterior or is within an unconditioned space shall be hot-dipped galvanized after fabrication.

E. Panels:
01 Roll-formed Galvalume®, pre-painted Galvalume® or Galvanized G90 Exterior-Side and G60 Interior-Side. In Canada, Galvanized panel will have a coating thickness of G90 on both sides.
02 Standing Seam Panels must have 50 percent minimum aluminum-zinc alloy- coating and conform to ASTM A-792 or ASTM A-653 with a minimum yield of 50 KSI.
03 Through-fastened panels must have 50 percent minimum aluminum-zinc alloy coating and conform to ASTM A-792 or ASTM A-653 with a minimum yield of 50 KSI.
04 Panel Finish:
a. PVDF Finish: 70% PVDF paint system with a 30-year finish warranty.

F. Panel Fasteners:
01 For Galvalume® and Painted finished roof panels: Long Life Cast Zinc head.
02 For wall panels: Coated carbon steel.
03 Color of exposed fastener heads to match the wall and roof panel finish.
04 Concealed Fasteners: Self-drilling type, of size required.

G. Flashing and Trim: Match material, finish, and color of adjacent components.

01 Provide trim at rakes, including peak and corner assemblies, high and low eaves, corners, bases, framed openings and as required or specified to provide weathertightness and a finished appearance.

H. Roof Clips:
01 All clips must have factory-applied mastic and designed so that movement between the panel and the clip does not occur.
02 Short or Tall Fixed clips; shall be either 3-1/2 or 4-1/2” in height. Used for applications where only a moderate amount of thermal expansion and contraction in the roof panel is expected.
03 Short or Tall Sliding clips: shall be either 3-1/2 or 4-1/2” in height and provide either 1-7/8” or 3 7/8” of travel for panel thermal expansion and contraction, depending on clip choice.

I. Sealant and Closures:
01 Sidelaps: Factory applied non-skinning Butyl mastic.
02 Endlaps, Eave, Ridge Assembly, and Gable Flashings: Field applied 100% solids butyl-based elastomeric tape sealant, furnished in pre-cut lengths.
03 Outside Closures: Closed-cell, plastic or metal.
04 Inside Closures: Closed-cell, plastic or metal.

2.3 PRIMARY FRAMING

A. Rigid Frames: Fabricated as welded built-up "I" sections or hot-rolled sections.
01 Frame Design: Gable

B. Rigid Frame Columns:
01 Tapered.

C. Rigid Frame Rafters:
01 Tapered.

D. Endwall Frames / Roof Beams:
01 Fabricate endwall columns of cold-formed "C" sections, mill-rolled sections, or built-up "I" sections depending on design requirements.
02 Depth or endwall columns shall be 8”.
03 Wall girt framing at endwalls shall be flush framed at endwall columns.

E. Interior Columns: Columns supporting rafters of mainframes shall be of the following cross-section type(s):
01 Tube (Square HSS).

F. Finish:
01 Interior: Hot-dipped galvanized after fabrication.
02 Exterior: Hot-dipped galvanized after fabrication.

G. Field Bolted Connections: All field bolted connections shall be designed and detailed utilizing ASTM A-325 or A-490 depending on design requirement.

2.4 SECONDARY FRAMING

A. Purlins and Girts: Purlins and girts shall be cold-formed "Z" sections with stiffened flanges.

01 Flange stiffeners shall be sized to comply with the requirements of the latest edition of AISI and LGSI.
02 They shall be pre-punched at the factory to provide for field bolting to the rigid frames.
03 They shall be simple or continuous span as required by design. Connection bolts will install through the purlin/girt webs, not purlin/girt flanges.

B. Purlins (Excluding Open Web Joists): Horizontal structural members which support roof coverings.
01 Depth: To be determined by design: 8”, 10” or 12”.
02 Maximum Length: To be determined by design.
03 Finish at Interior Members: Pre-Coated Galvanized.
04 Finish at Exterior Members: Pre-Coated Galvanized.

C. Girts: Horizontal structural members that support vertical panels.
01 Depth: To be determined by design: 8”, 10” or 12”.
02 Maximum Length: To be determined by design.
03 Finish at Interior Members: Pre-Coated Galvanized.
04 Finish at Exterior Members: Pre-Coated Galvanized.

D. Eave Struts: Unequal flange, cold-formed "C" sections or “Z” purlins.
01 Depth: To be determined by design: 8”, 10” or 12”.
02 Maximum Length: To be determined by design.
03 Finish at Interior Members: Pre-Coated Galvanized.
04 Finish at Exterior Members: Pre-Coated Galvanized.

E. Base Framing: Base members to which the base of the wall covering may be attached to the perimeter of the slab; secured to the concrete slab with mechanical anchors.
01 Base angle with flashing.
02 Finish at Interior Members: Pre-Coated Galvanized.
03 Finish at Exterior Members: Pre-Coated Galvanized.

F. Building Systems Roof Joist System.
01 Cold-formed purlins
02 Purlins shall be fabricated of material that conforms to the material specifications designated by the Steel Joist Institute as acceptable for this product.
03 Purlin attachment: Welded.

G. Wind Bracing:
01 When the wind load is applied in a direction such that it is not resisted by the transverse rigid frames, provision shall be made to adequately transmit all wind forces on the building to the foundation.
02 Provide diagonal roof rods, struts, wind columns, wind beams, etc., such that the forces are carried by truss action.
03 It will be noted that diagonal rod bracing in the walls is not acceptable.
04 Design of the building shall coordinate wind bracing to avoid conflict with doors and other openings through the exterior wall.

H. Flange Bracing: The inside flange of all rigid frames shall be braced laterally by angles connected to the flange and web of the frame and to the web of the purlin or girt so that the allowable compressive stress is adequate for any combination of loading.

2.5 ROOF AND WALLS PANELS

A. Roof Panels: **Refer to Section 07 41 13 – Metal Roof Panels.**

B. Wall, Liner and Soffit Panels: **Refer to Section 07 42 13 – Metal Wall Panels.**

C. Flashing and Trim: Refer to **Section 07 41 13 – Metal Roof Panels and Section 07 42 13 – Metal Wall Panels.**

D. The metal building system shall be designed and fabricated to accommodate the proper interface and installation of specified roof and wall panels.

2.6 ACCESSORIES

A. Canopies: **Refer to Section 10 73 26 – Aluminum Walkway Coverings**

B. Gutters and Downspouts: **Refer to Section 07 62 00 – Sheet Metal Flashing**

C. Purlin Extensions: Overhanging or projecting roof structure at the end of a building.

D. Framed Openings:
   01 Used to frame out doors, windows, louvers, and any other openings.
   02 Framing shall be “C” section type framing as required to provide the rough opening required for installation of hollow metal frames, window frames, louvers and vents, and other similar through-wall and / or work to be provided by others.
   03 Coordinate as required to provide proper opening sizes.

E. Roof Curbs:
   01 Welded units fabricated to integrate with metal roof panel profile application.
   02 Minimum 18-gauge Galvalume™ coated steel, with welds cleaned and treated with protective coating compatible with the Galvalume™ substrate.
   03 Top of curb to be level with ground, with 1 ½” top flange.
   04 Curb walls insulated with 1 ½”-3lb.density fiberglass insulation.
   05 Welded cricket on upslope side of curb to divert water.
   06 Metal or plastic rib covers supplied loose for flexibility when installing curb.
   07 Standard sub-frame shall be minimum 16-gauge steel and shall support all 4 sides of the curb.
   08 All fasteners and sealants required for installation shall be furnished by Roof Curb manufacturer.

F. Roof Ridge Vents:
   01 Provide individual or continuous roof ridge vents as indicated on the Drawings.
   02 Gravity Ridge Vents: Can be used as single unit or continuous.
      a. Size: 9” by 10’ with Damper & Lockerpull.
      b. Size: 12” by 10’ with Damper & Lockerpull.
   03 Provide cable control mechanism to open / close each ridge vent.

G. Pipe Flashings: Aluminum base with EPDM boot. The base flange must bend to form a seal with surface irregularities or roof pitch.
   01 Size: ¼" to 4" (6 to 102mm) Pipe.
   02 Size: 4" to 7" (102 to 178mm) Pipe.
   03 Size: 7" to 13" (178 to 330mm) Pipe.

2.7 OTHER COMPONENTS

A. Roof Curbs:
   01 Roof-top equipment curbs shall be specifically designed to interface with the roof panel profile.
   02 Curbs shall be fabricated from minimum 16-gauge galvanized sheet metal; and heavier where required to meet loads.
   03 Curbs shall be located to span the minimum number of panel seams. Coordinate with other trades as required to position interfacing work below the roof accordingly.
   04 Curbs shall be fabricated with integral crickets to divert water around the curb.
   05 Curbs shall be fabricated to account for roof slope so that all roof-top equipment is mounted level and plumb.
   06 Provide continuous secondary sub-framing at all sides of roof curbs.
   07 Finish at roof curbs shall match color of roofing panels.

B. Penetration Flashing:
   01 At pipe penetrations, provide a flexible, one-piece, flashing boot specifically made to be installed on metal roofing.
   02 Material shall be EPDM with a corrosion resistant aluminum collar for attachment to the roof panel.
   03 Design is based on "Dektite" Pipe Flashing; or an equal approved by the Architect.
   04 Flashing to be set on a full bed of sealant.
   05 All pipe flashing shall be installed on the 'flat' of the roof panel. Prior to making roof penetration, coordinate with other trades as required to ensure pipe flashing will not be installed on or over a panel ridge.

C. Ridge Vents:
   01 Design of ridge vents is based on R&S Manufacturing and Sales Co. Type "RV" ridge vent; or an equal approved by the Architect.
   02 Size: 12" throat x 10' length. Provide as separate vents or combined to form a continuous vent as indicated on the Drawings.
   03 Construction: Wind bands, skirts, diverters, and end caps shall be minimum 26-gauge galvanized steel.
   04 Internal gussets shall be a minimum 22 GA A653 galvanized or A463 aluminized steel.
   05 The roof ridge vent shall be preassembled from the manufacturer.
   06 Entire ridge vent shall be weather resistant with a top diverter, end caps, and wind bands to direct rain away from the vent opening.
   07 Operation: Lifting mechanism assembly shall open the vent damper when the pull bar is drawn to a closed position via cables located perpendicular to vent on wall below. Damper shall open and close in a vertical direction and controlled with a guide rod.
   08 Screening shall be #2 mesh 19 GA galvanized steel screen and is placed along the top opening of the vent.

09 Venting performance shall be as listed on the manufacturer's spec sheet and shall be based on providing intake air with the equivalent of 1-1/2 times the ventilator open area.

10 Internal braces and damper operator arms shall be a minimum 18 GA A653 galvanized or A463 aluminized steel.

11 Finish: External visible parts shall be either mill finish, a pre-coated SMP off white finish, or a custom color powder coat finish. Internal braces, operator parts, bird screen, or trim shall be mill finish.

2.8 RELATED ACCESSORIES

A. Refer to Section 08 11 13 – Hollow Metal Doors and Frames.

B. Refer to Section 07 21 00 – Thermal Insulation.

C. Refer to Section 08 90 00 – Louvers and Vents.

D. Fans: Refer to Mechanical Drawings and Division 23 for locations, conditions and additional information.

2.9 BUILDING ANCHORAGE & FOUNDATION

A. The building anchor bolts and related anchorage shall be designed to resist the column reactions resulting from the specified loads as applied in the specified loading combinations.

01 The sizes and design shall be specified by the building manufacturer.

02 Coordinate with the Contractor regarding supplying and installing anchor bolts.

2.10 FABRICATION

A. General:

01 Shop-fabricate all framing members for field bolted assembly. The surfaces of the bolted connections must be smooth and free from burrs or distortions.

02 Shop connections must conform to the manufacturer's standard design practices as defined in this section. Certification of welder qualifications will be furnished when required and specified in advance.

03 All framing members must carry an identifying mark.

B. Primary Framing:

01 Plates, Stiffeners and Related Members.: Factory weld base plates splice plates, cap plates, and stiffeners into place on the structural members.

02 Bolt Holes and Related Machining: Shop fabricate base plates, splices and flanges to include bolt connection holes. Shop fabricated webs to include bracing holes.

03 Secondary structural connections (purlins and girts) to be ordinary bolted connections, which may include welded clips.

04 Manufacturer is responsible for all welding inspection in accordance with the manufacturer's IAS Accreditation or CAN/CSA A660 Certification.

05 Non-Destructive Testing (NDT) - NDT shall be performed and documented as required by the governing building code for this project.

C. Zee Purlins:
   01 Fabricate purlins from cold-formed "Z" sections with stiffened flanges.
   02 Size flange stiffeners to comply with the requirements of the latest edition of AISI. Connection bolts will install through the webs, not the flanges.

D. Girts:
   01 Girts must be simple or continuous span as required by design.
   02 Connection bolts will install through the webs, not the flanges.

E. Column Base Plates:
   01 Heights of columns shall be designed to allow for a nominal 1/2" shim space below all primary framing base plates.

F. Diagonal Bracing:
   01 Wind bracing in the roof and/or walls need not be furnished where it can be shown that the diaphragm strength of the roof and/or wall covering is adequate to resist the applied wind or seismic forces.
   02 Diagonal bracing in the roof and sidewalls may be used to resist longitudinal loads (wind, crane, etc.) in the structure if diaphragm action cannot be used.
   03 Do not locate diagonal bracing at locations that interfere with openings in exterior walls.
   04 Diagonal bracing will be furnished to length and equipped with hillside washers and nuts at each end. It may consist of rods threaded each end or galvanized cable with suitable threaded end anchors. If load requirements so dictate, bracing may be of structural angle and/or pipe, bolted in place.

G. Special Bracing:
   01 When diagonal bracing is not permitted in the sidewall, a rigid frame type portal or fixed base column will be used.
   02 Shear walls can also be used where adequate to resist the applied wind or seismic forces.

H. Flange Braces:
   01 The compression flange of all primary framing must be braced laterally with angles connecting to the bottom chords of purlins or to the webs of girts so that the flange compressive stress is within allowable limits for any combination of loading.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The erector shall examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

B. Before erection proceeds, the erector survey elevations and locations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates and other embedment’s to receive structural framing for compliance with requirements and metal building system manufacturer’s tolerances.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads equal in intensity to design loads. Remove temporary supports when permanent structural framing connections and bracing are in place, unless otherwise indicated.

3.3 ERECTION - FRAMING

A. Erect framing in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.

B. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces, as well as loads due to erection equipment and erection operation.
   01 Temporary guys, braces, etc. shall not be anchored directly to the building slab.
   02 All temporary guys, braces, false-works and cribbing shall be removed immediately upon completion of erection.

C. Do not field cut or alter structural members without approval of the metal building manufacturer’s registered Structural Engineer.

D. After erection of all shop primed members, prime welds, abrasions, and marred surfaces resulting from erection / installation.

E. After erection of galvanized members, touch up all welds and abrasions with a zinc-rich / cold galvanizing paint

3.4 ERECTION - WALL AND ROOFING SYSTEMS

A. Install in accordance with reviewed Shop Drawings and manufacturer's standards and instructions.

B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.

C. Provide continuous sealant / sealant tape at all panel joints.

D. Fasten cladding system to structural supports, aligned level and plumb.

3.5 ERECTION - GUTTER AND DOWNSPOUT

A. Install in accordance with reviewed Shop Drawings and manufacturer's standards and instructions.

B. Connect downspouts to storm sewer system or provide precast concrete splash-blocks as indicated on the Drawings.

C. Provide strap anchors at 10’-0” maximum at all downspouts; minimum three (3) per downspout.

3.6 ERECTION - TRANSLUCENT PANELS

A. Install in accordance with reviewed Shop Drawings and manufacturer's standards and instructions.

B. Coordinate with installation of roofing system and related flashings.

C. Provide weather-tight installation.

3.7 INSTALLATION - ACCESSORIES

A. Refer to other Sections and coordinate with other trades as required for the proper installation and interface of Work not included in this Section. Work includes, but is not limited to:
   01 Hollow metal doors and frames
   02 Overhead doors
   03 Aluminum windows
   04 Louvers

B. Seal all accessories weather-tight.

3.8 TOLERANCES

A. All work shall be performed in a workmanlike manner.

B. Install Framing in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.

3.9 PROTECTION AND CLEAN-UP

A. Upon completion of the Work, remove all debris related to the Work of this Section.

B. Particular attention shall be made in removing metal shavings, screws, and other debris from roof panels.

C. Use all means necessary to protect installed work and finishes prior to Substantial Completion and acceptance by the Owner.

END OF SECTION

SECTION 22 02 00

BASIC MATERIALS AND METHODS FOR PLUMBING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departure and the reasons therefore shall be submitted to the Architect/Engineer for approval as soon as reasonably practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is equal to that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent Drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings, or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to: materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Plumbing and Fire Protection items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details with regards to locations of piping, appurtenances, etc. Exact locations are to be determined by actual measurements at the building/job-site, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least seven (7) working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified elsewhere, or necessary for complete and functioning plumbing systems shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the Commissioning process as required; including, but not necessarily limited to: meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the reviewed Shop Drawings.

B. The piping, fixture, and equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit Shop Drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be provided by the Contractor at no additional cost to the owner.

D. Additional coordination with Electrical Subcontractor may be required to allow adequate clearances of electrical equipment, fixtures, and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts, or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the piping, fixtures and equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified elsewhere. Prime and protective painting is included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to plumbing systems.

C. Furnishing and installing all required plumbing equipment, control relays and electrical interlock devices, conduit, wire and junction boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.7 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of Owner occupancy, or the date all punch list items have been completed, or the date final payment has been received. Refer to Division 01 for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such times as the project is ready to receive the fixtures, equipment, pipe, valves, etc. - properly protected from incidental damage and weather damage.

C. Damaged fixtures, equipment, valves, pipe, or appurtenances shall be promptly removed from the site and new, undamaged items shall be provided in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The plumbing systems and the component parts thereof shall be guaranteed to operate without objectionable noise, water hammering, and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping and other items.

C. Carefully fabricate pipe and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect/Engineer, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

E. Above ceiling piping and valves shall not be installed in direct contact with the work of other trades, including, but not limited to, suspended ceiling hanger wire.

1.10 APPLICABLE CODES

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection, relocation, and upgrade of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the nationally accepted codes and standards.

D. Such codes and standards shall include, but not necessarily be limited to:
   01 American Standards Association, ASA.
   02 American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
   03 American Society of Mechanical Engineers, ASME.
   04 American Society of Plumbing Engineers, ASPE.
   05 American Society of Testing Materials, ASTM.
   06 American Water Works Association, AWWA.
   07 National Bureau of Standards, NBS.
   08 National Fire Protection Association, NFPA.
   09 UL, LLC (formerly Underwriters Laboratories).
   10 FM Global.
   11 International Energy Conservation Code, IECC.
   12 International Fire Code.
   13 International Fuel Gas Code.
   14 International Plumbing Code.

E. Where differences exist between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Architect/Engineer in writing of all differences.

F. When directed in writing by the Architect/Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards. Correct the deficiencies and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver new to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its Subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 2009 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings. It will not be the province of the Specifications to address any part of the work which the Drawings can fully convey in every particular and such omission shall not to relieve the Contractor from carrying out portions of work indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least seven (7) working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution by made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing at least ten (10) days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification indicates that products of similar design and equal construction from the list of acceptable manufacturers may be used, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outlined herein.

I. Where equipment other than that used in the design as specified or shown on the Drawings is provided (either from an acceptable manufacturer list or by submittal review), it shall be the responsibility of the Contractor to coordinate space requirements, building provisions and connection requirements with all trades bear any additional costs.

J. Where permission to use a substitution product, material, or method is granted by the Owner or Engineer in writing, the Contractor shall bear full responsibility for the implementation of that substitution. Specific responsibilities shall include, but shall not be limited to, the following:

01 Verifying that the substituted item will fit in the space available. This shall include allowances for all code required clearances and manufacturer's maintenance and service clearances.

02 The coordination and provision of all necessary supports, hangers, and appurtenances. Hanger spacing shall be adjusted accordingly and any additional hangers or supports required shall be provided.

03 The coordination and provision of all necessary insulation, firestopping provisions, etc.

04 Adherence to manufacturer's published installation recommendations.

05 Adherence to requirements of the Authority Having Jurisdiction (AHJ) and provision of a code compliant installation.

06 Changes to architectural, structural, electrical, mechanical, and plumbing requirements as a result of the substitution.

07 Bearing any additional costs and time impact and providing any necessary redesign. The Owner will bear no such cost and make no time allowances.

08 Coordination of plumbing and electrical requirements and utility provisions with the Mechanical and Plumbing Design Documents and all other trades, including Division 26.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a written acceptance allowing the substitutions.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of Shop Drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty (30) day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive Shop Drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all Shop Drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

01 A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

02 An index page with a listing of all data included in the Submittal.

03 A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

04 Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

05 Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled. Provide at a scale as required (but no less than 1/8" = 1'-0") to demonstrate that the alternate or substituted product will fit in the space available.

06 Identification of each item of material or equipment matching that indicated on the Drawings.

07 Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

08 Additional information as required in other Sections of this Division.

09 Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on Shop Drawings and submittals.

C. Equipment and materials submittals and Shop Drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of Shop Drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where Shop Drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop Drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

01 REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

02 REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The Contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

03 NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

04 REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous Shop Drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

05 CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all Shop Drawings.

06 MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without Shop Drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Submittals are required for, but not necessarily limited to, the following items:

01 Basic Materials.
02 Plumbing Fixtures and Valves.
03 Supports and Carriers.
04 Floor Drains and Cleanouts.
05 Interceptors/Traps (All Types).
06 Water Heaters.
07 Expansion Tanks.
08 Backflow Preventers.
09 Plumbing Piping.
10 Piping, Vessel, and Equipment Insulation.
11 Expansion Fittings and Devices.
12 Variable Frequency Drives.
13 Noise and Vibration Controls.
14 Pipe and Equipment Hangers and Supports.
15 Plumbing Specialties.
16 Test, Adjust and Balance Reports.
17 Testing, Adjusting and Balancing Contractor Qualifications.
18 Coordination Drawings.

I. Refer to other Division 22 sections for additional Shop Drawing and submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to an appropriate scale (typically 1/4" = 1'-0" or larger); detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   01 Indicate the proposed locations of pipe, equipment, and other materials. Include the following:
      a. Wall locations and types.
      b. Clearances for installing and maintaining insulation.
      c. Locations of light fixtures and sprinkler heads.
      d. Clearances for servicing and maintaining equipment, including tube removal and space for equipment disassembly required for periodic maintenance.
      e. Equipment connections and support details.
      f. Exterior wall and foundation penetrations.
      g. Routing of storm, sanitary sewer piping and plumbing piping.
      h. Fire-rated wall and floor penetrations.
      i. Sizes and location of required concrete pads and bases.
      j. Valve stem movement.
      k. Structural floor, wall and roof opening sizes and details.
   02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
   03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting Shop Drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 22.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work; precise locations of all concealed pipe; locations of all valves, controls and operable devices; and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Record Drawings shall indicate, at a minimum, the following installed conditions:
   01 Mains and branches of piping systems, with valves and control devices located and numbered, unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion fittings, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
   02 Equipment locations (exposed and concealed), dimensioned from prominent building lines.
   03 Approved substitutions, Contract Modifications, and actual equipment and materials installed.
   04 Contract Modifications, actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

F. If the Contractor does not keep an accurate set of Record Documents, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

G. Upon completion of the Work, the Contractor shall submit three (3) full size sets of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS
DATE:
(NAME OF GENERAL CONTRACTOR)
BY: _____
(SIGNATURE)
(NAME OF GENERAL CONTRACTOR)
BY: _____

(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled dates for each test. This detailed completion and test schedule shall be submittal at least ninety (90) days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit four (4) copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in other Sections of Division 22.

1.17 OPERATIONS AND MAINTENANCE MANUALS

A. Prepare Operations and Maintenance manuals in accordance with the requirements of Division 01 and Division 22. In addition to the requirements of other Sections, this shall include operational, trouble-shooting, and routine maintenance information for fixtures, specialties, and equipment.

01 Identifying names, name tags designations and locations for all equipment.
02 Valve tag lists with valve number, type, color coding, location and function.
03 Reviewed Shop Drawing submittals with exceptions noted compliance letter.
04 Fabrication drawings.
05 Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
06 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
07 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
08 Servicing instructions and lubrication charts and schedules.
09 Equipment and motor name plate data.
10 Wiring diagrams.
11 Exploded parts views and parts lists for all equipment and devices.
12 Color coding charts for all painted equipment and conduit.
13 Location and listing of all spare parts and special keys and tools furnished to the Owner.
14 Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

B. Coordinate with Division 01 for Operations and Maintenance manual requirements. Unless noted otherwise, bind together in “D ring” style three-ring binders (National model no. 79-883 or equivalent). Binders shall be large enough to allow 1/4” of spare capacity. Include three (3) sets with all approved Shop Drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections with tabbed insertable dividers, labeled for easy reference. Utilize the individual specification section numbers shown in the Plumbing Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 22 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

C. In addition to the bound “hard-copy” Operation and Maintenance manuals referenced above, provide an identical electronic copy in searchable PDF format, with all sections bookmarked within the file for easy reference. Provide a USB flash drive with the final manual to the Owner.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of fourteen (14) working days prior to the beginning of the operator training period.

E. Operating and Maintenance Manuals which the Engineer deems incomplete, poorly organized, or otherwise unacceptable will be rejected in writing. The Contractor will subsequently be required to again turn over Operating and Maintenance Manuals, with all deficiencies corrected, until deemed acceptable by the Engineer.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel.

B. The Owner's operator training shall include a minimum of 12 hours of on- site training in three (3) shifts of four (4) hours each.

C. Before proceeding with the instruction of Owner’s Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period, obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he or she has a proper understanding of the operation and maintenance of the systems and then resubmit the signed outlines.

D. Refer to other Sections of Division 22 for additional Operator Training requirements.

1.19 FINAL COMPLETION

A. At the completion of the work, all equipment, operable appurtenances, and systems shall be tested. All faulty equipment and material shall be repaired or replaced. Refer to other Sections of Division 22 for additional requirements.

B. Clean and adjust all fixtures, flushometers, valves and operable devices. Replace faulty or otherwise damaged parts immediately prior to final acceptance.

C. Touch up and/or refinish any scratched equipment and devices immediately prior to final acceptance. This shall be acceptable only for minor superficial scratches, the determination of which rests solely on the judgment of the Architect or Engineer.

1.20 CONTRACTOR'S GUARANTEE

A. Use of the Plumbing systems to provide temporary service during the construction period shall not be allowed without written permission from the Owner, and, if granted, shall not be cause for the warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one (1) year after its completion and final acceptance, and shall furnish free of additional cost to the Owner all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of issue of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. All air compressors shall have parts and labor guarantees for a period of not less than five (5) years beyond the date of final acceptance.

E. Refer to other Sections of Division 22 for additional guarantee or warranty requirements.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for re-use by Architect/Owner or others on extensions of this project or on any other project. Any such re-use or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any re-use or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

01 It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

02 If the client, Architect or Owner of the project requires electronic media for “record purposes”, then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD’s. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

03 At the Architect/Owner’s request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a “.rvt” or “.dwg” format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with “Buy American Act.”

B. 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 screw driver cam locks unless indicated otherwise.

C. All access panels located in wet areas such as toilet rooms, locker rooms, shower rooms, natatoriums, kitchens, and any other wet areas shall be constructed of stainless steel.

D. Access doors shall be as follows:
   01 Plastic Surfaces: Milcor Style K.
   02 Ceramic Tile Surfaces: Milcor Style M.
   03 Drywall Surfaces: Milcor Style DW.
   04 Install panels only in locations approved by the Architect.

2.2 EQUIPMENT PADS

A. Provide four (4) inch high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of six (6) inches beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bull-nosed to a 3/4" radius, unless shown otherwise.

B. Provide six (6) inch high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of six (6) inches beyond the equipment. Provide a four (4) foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bull-nosed to a 3/4" radius, unless shown otherwise.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in other Divisions (10, 11, 12, 13, 21, 22, etc.) for additional rough-in requirements as necessary and provide accordingly.

3.2 PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing and fire systems, materials, and equipment. Comply with the following requirements:

01 Coordinate plumbing and fire protection systems, equipment, and materials installation with other building components.

02 Verify all dimensions by field measurements.

03 Arrange for chases, slots, leave-outs, and other openings in building components during progress of construction to allow for plumbing installations.

04 Coordinate the installation of required supporting devices, sleeves, and pathways to be set in poured-in-place concrete and other structural components, as they are constructed.

05 Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

06 Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

07 Coordinate connection of plumbing and fire protection systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

08 Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.

09 Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10 Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.

11 Install access panels or doors where valves, operable devices, and equipment are concealed behind finished surfaces. Refer to Article 2.1 of this Section and to Architectural documents for specifications and locations.

12 Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13 Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curb to match roof slope. Refer to architectural drawings and details.

14 The equipment to be furnished under this Specification shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.

15 The architectural and structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.

16 Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.

17 Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, valves, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.

18 Identification of Plumbing Equipment:

a. Plumbing equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Shop Drawings shall include dimensions and lettering format for approval. Attachments shall be with escutcheon pins, self-tapping screws, or machine screws.

b. Tags shall be attached to all valves, including control valves, with nonferrous chains. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the Record Drawings.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, removal, patching, replacement/repair as required to:

01 Uncover Work to provide for installation of ill-timed Work.

02 Remove and replace defective Work.

03 Remove and replace Work not conforming to requirements of the Contract Documents.

04 Remove samples of installed Work as specified for testing.

05 Install fixtures, equipment, piping, and appurtenances in existing structures.

06 Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.

07 Patch and replace/repair existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Article 1.11 DEFINITIONS AND SYMBOLS for definition of "Installer."

C. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, equipment, plumbing fixtures and trim, and other plumbing items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:

01 A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors and the Architect/Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

02 During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

B. Start-up for major plumbing and fire protection equipment shall be performed by a factory authorized technician. Such equipment shall include, but not necessarily be limited to, the following: domestic water boilers and packaged water heating systems, water softeners, ultra-pure water equipment systems, domestic water booster pumps, fire pumps, and break tank level alarm systems. Refer to other Sections of Divisions 21 and 22 for additional requirements.

END OF SECTION

SECTION 22 02 01

COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 01 31 00 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Contractor will be provided with the REVIT model that was used to generate the contract documents and this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT and may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4" scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

01 Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

a. Wall and type locations.
b. Clearances for installing and maintaining insulation.
c. Locations of light fixtures and sprinkler heads.
d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
e. Equipment connections and support details.
f. Exterior wall and foundation penetrations.
g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.

j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling mounted items.

H. Sequence of Coordination

Below is hierarchy of model elements and the sequencing by which the models will be coordinated.

01 Structural and Architectural model
02 Miscellaneous steel
03 Perform preliminary space allocation
04 Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
05 Main and medium pressure ducts from the shaft out
06 Main graded plumbing lines and vents
07 Cold and hot water mains and branches
08 Lighting fixtures and plumbing fixtures
09 Smaller sized ducts and flex ducts
10 Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. The Contractor shall be responsible for coordination of all items that will affect the installation of the Work. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, the Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all trades.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 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. Provide electric motors, control panels, control and safety devices, and control wiring when specified or as required for proper operation of electrical systems associated with plumbing equipment and appurtenances.

B. WORK SPECIFIED ELSEWHERE:
   01 Painting.
   02 Power control wiring to motors and equipment.

1.3 WARRANTY

A. Warrant the Work specified herein for one year and motors for five years beginning on the date of substantial completion against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures variations, and accessories.

C. MOTOR NAMEPLATE INFORMATION: Manufacturer's name, address, utility and operating data.

D. Refer to Division One for additional information.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.

B. TIME AND COORDINATION: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.

C. STORAGE: Store materials in a clean, dry location, protected from weather and abuse.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. APPROVED MANUFACTURERS: Provide motors by a single manufacturer as much as possible.
   01 Baldor
   02 Marathon
   03 Leeson-Lincoln Electric
   04 General Electric
   05 Westinghouse

B. TEMPERATURE RATING: Provide insulation as follows:
   01 CLASS B: 40 degrees C maximum.
   02 CLASS F:
      a. Between 40 degrees C and 65 degrees C maximum.
      b. Totally enclosed motors.

C. STARTING CAPABILITY: As required for service indicated five starts minimum per hour.

D. PHASES AND CURRENT: Verify electrical service compatibility with motors to be used.
   01 UP TO 3/4 HP: Provide electronically commutated brushless DC single phase motors with built-in inverter and microprocessor-based control.
   02 1 HP AND LARGER: Provide squirrel-cage AC induction polyphase motors.
   03 Name plate voltage shall be the same as the circuit's normal voltage, serving the motor.

E. SERVICE FACTOR: 1.15 for polyphase; 1.35 for single phase.

F. FRAMES: U-frames 1.5 hp. and larger.

G. BEARINGS: Provide sealed re-greasable ball bearings; with top mounted zerc lubrication fittings and bottom side drains minimum average life 100,000 hours typically, and others as follows:
   01 Design for thrust where applicable.
   02 PERMANENTLY SEALED: Where not accessible for greasing.
   03 SLEEVE-TYPE WITH OIL CUPS: Light duty fractional horsepower motors or polyphase requiring minimum noise level.

H. ENCLOSURE TYPE: Provide enclosures per applications as follows:
   01 CONCEALED INDOOR: Open drip-proof (ODP).
   02 EXPOSED INDOOR: Splash-proof.
   03 OUTDOOR TYPICAL: Type III, totally enclosed fan-cooled (TEFC).
   04 OUTDOOR WEATHER PROTECTED: Weather protected II (WPII).
   05 HAZARDOUS LOCATIONS: Explosion-proof.

I. OVERLOAD PROTECTION: Built-in sensing device for stopping motor in all phase legs and signaling where indicated for fractional horse power motors.

J. NOISE RATING: "Quiet" except where otherwise indicated.

K. EFFICIENCY: Minimum full load efficiency listed in the following table, when tested in accordance with IEEE Test Procedure 112A, Method B, including stray load loss measure.

NEMA Efficiency - 1800 RPM Synchronous Speed		
Motor Horsepower	Index Letter	Minimum Efficiency %
3 - 5	G	89.5
7.5	G	91.0
10	F	91.7
15 - 20	E	93.0
25 - 30	E	93.6
40	D	94.1
50	C	94.5
60	C	95.0
75	C	95.0
100 - 125	B	95.4
150 - 200	B	95.8
NEMA Efficiency - 1200 RPM Synchronous Speed		
Motor Horsepower	Index Letter	Minimum Efficiency %
3 - 5	G	89.5
7.5	G	90.2
10	F	91.7
15	F	91.7
20	E	92.4
25 - 30	E	93.6
40 - 50	D	94.1
60	D	94.5
75	C	94.5
100 - 125	C	95.0
150 - 200	B	95.4

2.2 MOTOR CONTROLLERS (STARTERS)

A. All motor controllers (for equipment furnished under Division 22) shall be furnished under Division 22 and installed under Division 26 unless otherwise noted on the plans.
   01 Starters shall be provided for 3 phase motors 1 horsepower and greater.

B. Motor starters shall be furnished as follows.
   01 GENERAL: Motor starters shall be Square D Company Class 8536 across-the-line magnetic type, full-voltage, non-reversing (FAVOR) starter. All starters shall be constructed and tested in accordance with the latest NEMA standards, sizes and horsepower. ICE sizes are not acceptable. Starters shall be mounted in a general purpose dead front, painted steel enclosure and surface-mounted. Provide size and number of poles as shown and required by equipment served. Provide two speed, two winding or two speed, single winding motor starter as required for two speed motors.
   02 CONTACTS: Magnetic starter contacts shall be double break solid silver alloy. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.
   03 OPERATING COILS: Operating coils shall be 120 volts and shall be of molded construction. When the coil fails, the starter shall open and shall not lock in the closed position.

04 OVERLOAD RELAYS: Provide manual reset, trip-free Class 20 overload relays in each phase conductor in of all starters. Overload relays shall be melting alloy type with visual trip indication. All 3 phase and single phase starters shall have one overload relay in each underground conductor. Relay shall not be field adjustable from manual to automatic reset. Provide 6 overload relays for two speed motor starters.

05 PILOT LIGHTS: Provide a red running pilot light for all motor starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.

06 CONTROLS: Provide starters with HAND-OFF-AUTOMATIC switches. Coordinate additional motor starter controls with the requirements of Division 22. Motor starter controls shall be mounted in the starter enclosure cover.

07 CONTROL POWER TRANSFORMER: Provide a single-phase 480 volt control power transformer with each starter for 120 volt control power. Connect the primary side to the line side of the motor starter. The primary side shall be protected by a fuse for each conductor. The secondary side shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.

08 AUXILIARY CONTACTS: Each starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock", remote monitoring, and control wiring. In addition, it shall be possible to field-install three more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.

09 UNIT WIRING: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for line and load power wiring and HVAC control wiring.

10 ENCLOSURES: All motor starter enclosures shall be NEMA 1, general purpose enclosures or NEMA-3R if mounted exposed to high moisture conditions. Provide NEMA 4X when located by cooling towers, fountains, or similar locations.

11 POWER MONITOR: Provide a square "D" 8430 MPS phase failure and under-voltage relay, base and wiring required for starters serving all 3 phase motors. Set the under-voltage setting according to minimum voltage required for the motor to operate within its range.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturers.

01 Siemens.
02 Square D.
03 General Electric.
04 Eaton.

2.3 COMBINATION MOTOR STARTERS

A. GENERAL: Combination motor starters shall consist of a magnetic starter and a fusible or non-fusible disconnect switch in a dead front, painted steel NEMA 1 enclosure unless otherwise noted and shall be surface-mounted. Size and number of poles shall as shown and required by equipment served. Combination motor starters shall be as specified for motor starters in Paragraph 2.1/B, except as modified herein.

B. DISCONNECT SWITCH: Disconnect switches shall be as specified in Division 26.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturers.

01 Siemens.
02 Square D.
03 General Electric.

PART 3 - EXECUTION

3.1 INSTALLATION

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 on the plans or in the specifications. Contractors' price shall include all items required as per manufacturer's requirements.

C. Install in a professional manner. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to Owner.

D. Install rotating equipment in static and dynamic balance.

E. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building.

F. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fittings and items covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:
01 Expansion joints and compensators.
02 Pipe loops, offsets, and swing joints.

1.3 RELATED WORK

A. Section 22 02 00 - Basic Materials and Methods for Plumbing

B. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

C. Section 22 10 00 - Plumbing Piping

1.4 REFERENCES

A. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NSF 61 - Drinking Water System Components - Health Effects; 2024.

1.5 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:
01 Installation Temperature: 50 degrees F (10 degrees C).
02 Domestic Hot Water: 140 degrees F (60 degrees C).
03 Safety Factor: 30 percent.

C. Pipe sizes indicated are to establish a minimum quality of compensator. Refer to manufacturer's literature for model series for different pipe sizes.

1.6 SUBMITTALS

A. Submit shop drawings under provisions of Division One.

B. Product Data:
   01 Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
   02 Pipe loops, offsets, and swing joints: Indicate temperature rise, developed lengths, pipe size, material expansion coefficient-allowable stress-modulus of elasticity, and final calculated amount of expansion. Indicate bend, loop, offset & return dimensions coinciding with the calculated expansion.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of expansion joints, fittings, anchors, and guides.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include adjustment instructions.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Design expansion compensation system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the project is located.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, project and handle products to site under provisions of Division One.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.11 WARRANTY

A. Provide five year warranty under provisions of Division One.

B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.12 EXTRA MATERIALS

A. Furnish under provisions of Division One.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Bellows Type (Based on 4" Pipe):
   01 Manufacturers:
      a. VMC Group, Style EB
      b. Triplex, Model Resistoflex R6905
      c. Mercer Rubber Company, Style 803 or 805 (Mason Industries)
      d. Metraflex
   02 Body: Monel wire reinforced molded TFE teflon bellows, multiple arch.
   03 Pressure Rating: 70 psig WSP and 250 degrees F (66 degrees C).
   04 Maximum Compression: 1 inch.
   05 Maximum Extension: 1 inch.
   06 Maximum Offset: 1/2 inch.
   07 Joint: ASA standard ductile iron flanges, integral molded gasket.
   08 Size: Use pipe sized units.
   09 Accessories: Control rod limit bolts.
   10 Application: Steel piping 8 inch and under.

B. Pre-manufactured Loop Type:
   01 Manufacturers:
      a. Flexicraft Industries
      b. Metraflex MLS-UPC-80 series
   02 Materials of construction: Copper custom 180 degrees bend (or 90 degree elbows with spool), copper 90 degree elbows for connections to piping, bronze hose and braid.
   03 Certifications: NSF 61 lead-free compliant, IAPMO (UPC) approved.
   04 Working Pressure: No less than 200 psi at 250 degrees F.
   05 Allowable Movement: +/- 4 inches.
   06 Labeled from the manufacturer and provided complete with attached support bracket and drain plug.
   07 Size: Same as piping being served.
   08 Installation: In strict accordance with manufacturer's recommendations, including support.
   09 Application: Copper piping 4 inch and under.

2.2 ACCESSORIES

A. Pipe Alignment Guides to Direct Axial Movement:
   01 Manufacturers:
      a. Triplex, Model Flexonics
      b. Metraflex
   02 Welded steel construction bolt together two piece design, frame with four mounting holes, shop painted, spider type guide, exact style/model as necessary for bare or insulated pipe to match size and thickness as appropriate, 4 inch movement standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide miscellaneous metals to rigidly anchor pipe to building structure. Provide pipe guides so that movement takes place along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

C. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. This shall include where piping crosses expansion joints in the building.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division One.

B. Provide inspection services by manufacturer's representative for final installing and to certify the installation is in accordance with manufacturer's recommendations and expansion joints and accessories are performing satisfactorily.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORT FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe, and equipment hangers, supports, and associated anchors.

B. Sleeves and seals.

C. Flashing and sealing equipment and pipe stacks.

1.3 RELATED WORK

A. Section 22 02 00 - Basic Materials and Methods for Plumbing

B. Section 22 07 19 - Plumbing Piping Insulation

C. Section 22 10 00 - Plumbing Piping

D. Section 22 11 21 - Natural Gas Piping Systems

1.4 REFERENCES

A. ASME B31.1 - Power Piping; 2024.

B. ASME B31.9 - Building Services Piping; 2020.

C. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.5 QUALITY ASSURANCE

A. Hangers and Supports for Plumbing Piping: In conformance with ASME B31.1 and ASME B31.9.

B. Hangers and Supports for Plumbing Piping: In conformance with MSS SP-58.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 to 4 Inches Carbon steel, adjustable, clevis.

C. Hangers for Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.

E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

F. Wall Support for Pipe Sizes 4 Inches and Over: adjustable steel yoke and cast iron roller.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

J. Roof Pipe Supports and Hangers: Free-standing manufactured pipe support system with hot dip galvanized steel components and hardware with UV-inhibited injection molded high density/high impact black polypropylene base material. Portable Pipe Hangers, Inc. or approved equal.

For pipes 2-1/2” and smaller	Type PP10-R, with pipe roller support
For pipes 3” through 8”	Type PS-1-2, with pipe roller support
For multiple pipes	Type PSE - Custom

K. Copper Pipe Support and Hangers: Electro-galvanized with thermoplastic elastomer cushions; Unistrut “Cush-A-Clamp” or equal. Hangers: Plastic coated; Unistrut or equal.

L. For installation of protective shields also reference Section 22 07 19.

M. Shields for Vertical Copper Pipe Risers: Sheet lead.

N. Pipe Rough-In Supports in Walls/Chases: Provide pre-formed plastic pipe supports, Sioux Chief “Pipe Titan”, Hold Rite or equal.

2.2 HANGER RODS

A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

A. Inserts: 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. Metal Flashing: 20 gage galvanized steel.

B. Lead Flashing: 4 lb./sq. ft. sheet lead for waterproofing.

C. Caps: Steel, 20 gauge minimum; 16 gage at fire resistant elements.

D. Coordinate with roofing contractor/architect for type of flashing on metal roofs.

2.5 EQUIPMENT CURBS

A. Fabricate curbs of hot dipped galvanized steel.

2.6 ROOFTOP PIPE SUPPORTS

A. All roof-mounted piping shall be supported with engineered pre-fabricated piping support systems specifically designed to be installed on the roof without roof penetrations, flashing, or damage to the roofing material.
   01 Bases shall be made of UV protected HDPE.
   02 Frames shall be made of hot dipped galvanized strucutral steel.
   03 Nuts, threads, and washers shall be hot dipped galvanized steel.
   04 System shall be specifically designed to fit the piping and the actual conditions of service.
   05 Wood supports are not acceptable.
   06 Portable Pipe Hanger (PHP) system or pre-approved equal, installed per manufacturer’s instructions.

2.7 SLEEVES

A. All pipe penetrations through walls, floors, floor-ceiling assemblies, etc. shall be sleeved to ensure no direct contact between the pipe and that which it passes through. All installations shall be provided consistent with the fire and smoke safeguards required by the building code per the fire-resistance rating as indicated on the architectural drawings and shall be provided consistent with the assemblies/methods indicated on the architectural drawings.

B. Unless required otherwise (the most stringent requirement shall govern), sleeves for pipes:
   01 Through nonfire-resistance-rated floors shall be formed with 18 gage galvanized steel, tack welded to form a uniform sleeve.
   02 Through nonfire-resistance-rated walls, through grade beams and foundation walls, and through potentially wet floors shall be formed with schedule 40 steel pipe, galvanized.
   03 Through assemblies including but not limited to fire-resistance-rated walls-barriers-partitions, smoke barriers-partitions, etc. shall be schedule 40 steel pipe securely fastened to the rated assembly. All annular spaces shall be firestopped with an approved penetration firestop system (UL listed) compatible with the pipe material and installed per the manufacturer's recommendations.

C. Fire Stopping Insulation: Glass fiber type, non-combustible, UL listed.

D. Caulk: Paintable 25-year acrylic sealant.

E. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.8 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.9 FINISH

A. Exposed steel hangers, supports, and appurtenances shall be hot-dipped galvanized. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with structural engineer for placement of inserts.

B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX/ HANGER SPACING	HANGER DIAMETER
(Steel Pipe)		
1/2 to 1-1/4 inch	7'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(Copper Pipe)		
1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
6 to 8 inch	10'-0"	1/2"
(Cast Iron Pipe)		

2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"
10 inch and over	4'-0"	5/8"

B. Sagging of horizontal pipe is unacceptable.

C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

D. Place a hanger within 12 inches of each horizontal elbow and at the vertical horizontal transition.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers. Also reference specific requirements for cast iron piping installation in Section 22 10 00, Part 3 Execution.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. For vertical shaft or chase applications where floor slab supported riser clamps cannot be provided to keep the pipe in alignment and to support the weight of the pipe and its contents, ensure to provide suitable fasteners and hardware, braces, unistrut, structural steel members, etc. to accommodate the pipe installation. Coordinate all such work with the project structural engineer to ensure that necessary members and attachment points are provided accordingly to bear the weight of the functioning piping.

I. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

J. Support riser piping independently of connected horizontal piping.

K. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.

3.3 INSULATED PIPING

A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation. Secure the full contact area of the saddle to the pipe insulation with 1/8” thick coat of mastic.

C. Shields: Install protective shields MSS Type 40 on insulated piping that has vapor barrier. Secure the full contact area of the shield to the pipe insulation with 1/8” thick coat of mastic.

D. Galvanized sheet metal shields shall span an arc of 180 degrees and shall have dimensions not less than the following:

Nominal Pipe Size	Shield Length	Gauge Thickness
1/4 through 3-1/2 inch	12 inch	18
4 inch	12 inch	16
5 through 6 inch	18 inch	16
8 through 14 inch	24 inch	14
16 through 24 inch	24 inch	12

E. Ensure to provide an insert of high density insulation (calcium silicate) at each hanger/support to prevent the weight of the pipe from otherwise crushing the insulation. This insert material shall be at least as long as the associated protective shield.

F. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct support of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor shower mop sink and all other drains watertight to adjacent materials.

E. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Contact architect for all flashing details and roof construction. Seal penetrations watertight.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermafiber and 3M caulking and provide floor plate.

C. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with UL listed fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of vibration & sound control products and seismic controls covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:
   01 Vibration and shock mounting.
   02 Flexible pipe connectors.
   03 Seismic restraints.

1.3 RELATED WORK

A. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

B. Section 22 10 00 - Plumbing Piping

C. Section 22 30 00 - Plumbing Equipment

1.4 REFERENCES

A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NFPA 99 - Health Care Facilities Code; 2024, with Errata.

C. NSF 61 - Drinking Water System Components - Health Effects; 2024.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of vibration control and seismic products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria (NC) curves for all equipment at full load conditions.

C. Unless indicated otherwise, sound and vibration control products and seismic products shall be provided by a single manufacturer.

1.6 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. VMC Group

B. Mason Industries, Inc.

C. Kinetics Noise Control, Inc.

D. Vibration Eliminator Co., Inc.

E. Vibro-Acoustics

F. Unisource Manufacturing (as specifically noted below)

2.2 GENERAL

A. Provide vibration isolation supports for equipment, piping and appurtenances to prevent transmission of vibration and noise to the building structure that may cause discomfort to the occupants.

B. Provide seismic restraints, supports, and attachments suitable for the applicable seismic loads in seismic design category areas as required by the ICC (IBC) and local code requirements.

C. Where Basis of Design manufacturer and model numbers are indicated, the products of the other listed manufacturers above will be acceptable provided they comply with all of the requirements of this specification.

2.3 BASE MOUNTED PUMPS

A. Provide VMC Group model SP-NR, style E, elastomeric isolation pads consisting of two layers of 3/8'' thick alternate ribbed elastomeric pad bonded to a 16 gauge galvanized steel separator plate.

B. Pads shall be sized for approximately 40 psi loading and 1/8'' deflection.

C. Provide inertia bases for all base mounted pump applications in which the pumps are to be installed on any floor level other than the ground floor or grade level. Inertia bases shall also be provided for base mounted pump applications in which the associated room where they are housed is in a noise sensitive location, regardless of floor level.

2.4 FLOOR MOUNTED AIR COMPRESSORS, VACUUM PUMPS, AND SIMILAR EQUIPMENT

A. Provide VMC Group model CAL-2 aluminum housed isolators sized for 2” static deflection. Cast iron or steel housings may be used provided they are hot-dip galvanized after fabrication.

B. If floor mounted equipment is furnished with an internal vibration isolation option, provide VMC Group model SP-NRC, style E, consisting of two layers of 1" thick ribbed elastomeric pad bonded to a 16 gauge galvanized steel separator plate to address high frequency breakout and afford additional unit elevation for required drains. Ribbed elastomeric pads shall be located in accordance with the equipment manufacturer’s recommendations.

2.5 PIPING

A. Provide line size stainless steel flexible connectors at connections to air compressors, domestic boosters, and other pumps (excluding submersible pumps and small circulators).
   01 Type 321 SS annular corrugated interior hose.
   02 Type 304 SS single braid exterior hose.
   03 End connection type(s) as suited for the application and the equipment and piping being served, but in no case welded or soldered ends.
   04 Ensure NSF 61 compliance for all potable water applications.
   05 When applied with dissimilar pipe materials, dielectric connections must be provided at both ends.

B. For medical gas applications (or similar), flexible connectors at intake and outlet of medical air compressors and vacuum pumps shall be specifically produced for such use:
   01 They shall be documented, purged, and brazed to NFPA 99 standards.
   02 They shall be cleaned, capped, and bagged in accordance with CGA (Compressed Gas Association) G-4.1.
   03 Bronze hose and braid, copper return elbow, and copper sweat end connections. Sizes 2-1/2" through 4" shall utilize stainless steel hose and braid, stainless steel return elbow, and copper sweat end fittings silver brazed to the assembly.
   04 Unisource Manufacturing Series 455 "MedFlex"

2.6 CORROSION PROTECTION

A. All vibration isolators shall be designed and treated for resistance to corrosion.

B. Steel components: PVC coated or phosphated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

3.1 INSTALLATION

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 on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

C. The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the items covered by this Section, with all appurtenances, ready for owner's use.

B. All plumbing piping shall be appropriately labeled.

C. Refer to Architectural Sections for any additional requirements.

1.3 RELATED WORK

A. Section 22 10 00 - Plumbing Piping

B. Section 22 07 19 - Plumbing Piping Insulation

1.4 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

PART 2 - PRODUCTS

2.1 VALVE AND PIPE IDENTIFICATION

A. Valves:

01 All valves shall be identified with a 1-1/2" diameter brass valve tag with stamped, black or red filled characters. Service designations shall be 1/4" letters and valve numbers shall be 1/2" numbers. Secure tags to valve handles by use of copper or Monel wire seals. For any services not identified below, contact Engineer in advance for approval. Service designations:

a. Domestic cold water: DCW
b. Domestic hot water: DHW
c. Domestic hot water return: DHWR

02 All valves on the project shall be numbered sequentially, with valves for any one system and/or trade grouped together.

03 Valve tags are not required if the valve is located within 3'-0" of the equipment being served and the service is obvious.

04 Catalog a complete written record of all valves on the project, whether tagged or not. Include manufacturer, model number, size, service, system pressure (if like services with differing pressures are present on the project), location, valve tag data, and a description of the equipment/room/area served. Any valves which must be operated in sequence shall be indicated as such. Prepare a valve chart/schedule with all such information and include this chart/schedule in the project Operating and Maintenance Manual.

05 Mark all valve locations on the record drawings with appropriate identifying symbols or information to align with the above referenced valve chart/schedule. In addition to the O&M submission, provide the Owner with a digital copy (PDF format) of all such information in high-resolution, suitable for printing as full size drawings.

06 Tags and fastenings shall be manufactured by the Seton Nameplate Corporation or approved equal.

07 In addition to tags, all isolation valves serving emergency safety fixtures shall be provided with immediately adjacent clear and permanent signage indicating their purpose so as to avoid accidental shut-off.

B. Pipe Marking:

01 All interior visible piping located in accessible spaces shall be provided with pipe markers. Accessible spaces shall include, but not necessarily be limited to, the following: above accessible ceilings, inside equipment rooms and utility spaces, in attic spaces, in crawl spaces, and in chase spaces, etc. viewable via access panels.

02 All exterior visible piping shall be provided with pipe markers.

03 Peel-off, self-adhesive, sticker type labels shall not be acceptable.

04 Pipe markers shall be manufactured with rigid vinyl PVC, printed with UV resistant ink, abrasion and chemical resistant, suited for indoor or outdoor use and for a service temperature of -40 degrees F to 160 degrees F.

a. For pipes up to 6” provide cylindrically pre-coiled markers that snap into place without the need for tape or adhesives.

b. For pipes 6” and larger provide flat snap-around markers installed using manufacturer’s heavy-duty nylon ties or stainless steel strapping.

c. Markers shall indicate the pipe service, include flow directional arrows, and meet ASME A13.1.

05 Acceptable manufacturers:

a. Seton Setmark Pipe Markers

b. Brimar Industries Pipemarker System 1 Pipe Markers

c. Brady Corporation

06 Markers shall be provided after final insulating, painting, jacketing, etc. of piping and per manufacturer’s installation instructions. Strapping (applies to large diameter markers only) shall be snug but shall not compromise any insulation. All such strapping shall also be cleanly trimmed of excess material.

07 Markers shall be provided in accordance with ASME A13.1 requirements. Specific items indicated below are not intended as a substitute for this complete standard. Markers shall be provided:

a. On both sides of each floor or wall penetration.

b. On each side of each tee.

c. On each side of each valve and/or valve group.

d. On each side of each piece of equipment.

e. On straight pipe runs at equally spaced intervals not to exceed 50 feet.

f. In congested areas, on each pipe at the point it enters and exits the area.

g. At the point of connection to each piece of equipment and automatic control valve.

h. Where they are readily visible to personnel from the point of normal approach.

i. With letter height and length of color field according to the size of the pipe served.

j. For non-potable water not less than once per room and at equally spaced intervals not to exceed 20 feet.

08 Color scheme of markers shall be as indicated below and otherwise in accordance with ANSI/ASME color recommendations. Legend color indicates color of legend text and flow directional arrow:

SYSTEM	LABEL COLOR	LEGEND	LEGEND COLOR
Sanitary Sewer	Green	Sanitary Sewer	White
	Green	Plumbing Vent	White
Storm Drain	Green	Storm Drain	White
Domestic Water	Green	Domestic Cold Water	White
Domestic Hot Water	Green	Domestic Hot Water	White
Domestic Hot Water Return	Green	Domestic Hot Water Return	White

C. Pipe Painting:

01 Pipe painting shall be per the color schedule below or as directed by the Architect. Confirm all color selections with Architect prior to installation, in particular for exposed piping in publicly occupiable areas.

02 All exterior piping shall be painted.

03 All piping subject to corrosive conditions shall be painted. This shall include, but not necessarily be limited to: natatoriums, pool equipment rooms, chemical and metal processing areas, and animal pens.

04 All exposed piping shall be painted (including, but not limited to: piping in mechanical rooms, kitchens, and storage rooms).

05 Paint color schedule:

System	Color
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange

2.2 EQUIPMENT IDENTIFICATION

A. Plumbing equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. All labeling equipment shall be installed per manufacturer’s printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor’s price shall include all items as required per manufacturers' requirements.

C. All piping to be painted shall be cleaned of rust, dirt, grease, oil and all other contaminants prior to painting. Provide primer if and as recommended by the paint manufacturer. Provide a quality polyamine epoxy paint over all surfaces of pipe.

END OF SECTION

SECTION 22 07 16

PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 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.

B. Work specified elsewhere.
   01 Basic materials and methods.
   02 Piping systems.

1.3 REFERENCES

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

C. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 WARRANTY

A. Warrant the Work specified herein for one 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:
   01 Mildewing.
   02 Peeling, cracking, and blistering.
   03 Condensation on exterior surfaces.

1.5 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.6 DELIVERY AND STORAGE

A. DELIVERY: Deliver undamaged materials in the manufacturer's unopened containers clearly labeled with flame and smoke ratings.

PART 2 - PRODUCTS

2.1 EQUIPMENT INSULATION

A. It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

B. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.

C. A sample quantity of each type insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

D. Glass mineral wool materials as manufactured by Knauf Insulation, Owens/Corning, Certain-Teed or Johns Manville will be acceptable, if they comply with the specifications.

E. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 and UL 723.

F. All insulation shall comply with minimum requirements of International Energy Conservation Code ICC (IECC) and ASHRAE Std 90.1 I-P.

G. Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

H. All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All insulation 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 on the plans or in the specifications. Provide all items required as per manufacturers requirements.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 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.

B. Furnish and install piping insulation to:
   01 Interior domestic hot water and hot water return piping.
   02 Interior domestic cold water piping.
   03 Condensate drainage piping.
   04 All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.
   01 Painting.
   02 Pipe hangers and supports.

D. For insulation purposes, piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer wells, unions, pressure reducing stations, and orifice assemblies.

1.3 RELATED SECTIONS

A. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

B. Section 22 05 53 - Identification for Plumbing Piping and Equipment

C. Section 22 10 00 - Plumbing Piping

1.4 REFERENCES

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).

D. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation; 2019.

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.

G. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.

H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

I. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation; 2019.

J. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.

K. ASTM C1710 - Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form; 2022.

L. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation; 2021.

M. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation; 2021.

N. ASTM D1644 - Standard Test Methods for Nonvolatile Content of Varnishes; 2001.

O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

P. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

Q. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

R. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

S. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

T. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

U. MIL-A-24179 - Adhesive, Flexible Unicellular-Plastic Thermal Insulation; 1969a (Validated 2020).

V. MIL-DTL-3316 - Adhesives, Fire-Resistant, Thermal Insulation; 2020d.

W. NACIIS - North American Commercial and Industrial Insulation Standards Manual; current edition.

X. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

Y. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

Z. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

B. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.
   01 Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

C. All piping insulation thicknesses shall comply with ICC (IECC) and ASHRAE Std 90.1 I-P.

D. Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

E. Adhesives, mastics, and sealants used on the interior of the building shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D

F. All insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

G. All insulations shall be UL GREENGUARD Gold certified.

H. Fiberglass insulations shall have a minimum of 50 percent recycled glass content.

I. Foam insulation materials shall be manufactured without the use of chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) blowing agents.

1.6 WARRANTY

A. Warrant the Work specified herein for one 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:
   01 Mildewing.
   02 Peeling, cracking, and blistering.
   03 Condensation on exterior surfaces.

1.7 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.8 DELIVERY AND STORAGE

A. Deliver insulation materials to site in unopened containers with manufacturer's product name, ASTM standard designation, type and grade, maximum use temperature, nominal dimensions, manufacturer lot or date code.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

C. Store insulation indoors and keep free from exposure to UV and precipitation.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

A. It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

B. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved prior to installation.

C. A sample quantity of each type of insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

D. Any existing piping located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E84 testing requirements shall be provided with a single layer of high-temperature insulation to establish a noncombustible rating per ASTM E136. Insulation products which are approved for such non-compliant combustible piping materials located air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

2.2 APPROVED MANUFACTURERS

A. Fiberglass/glass mineral fiber materials shall be as manufactured by Knauf Insulation, Johns Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.

B. Adhesives, mastics, and sealants shall be as manufactured by 3M company, Armacell, Foster/Childers, Mon-Eco Industries, or Vimasco Corporation and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

C. Flexible elastomeric cellular thermal insulation shall be as manufactured by Armacell.

D. Phenolic foam insulation shall be as manufactured by Resolco, Inc. (Insul-Phen) or Polyguard (Poly-phen).

E. Metal jacketing and fitting covers shall be as manufactured by Johns Manville or RPR Products, Inc.

2.3 MATERIALS

A. INTERIOR DOMESTIC WATER PIPE: Provide fiberglass/glass mineral fiber preformed pipe insulation in accordance with ASTM C547, Type I and IV; ASTM C585, ASTM C411, and ASTM C795 with ASJ+ SSL+ vapor retarder jacket complying with ASTM C1136. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.23 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 1,000 degrees F. Provide Knauf Insulation Earthwool 1000 Insulation with ECOSE Technology or approved equal.

B. CONDENSATE AND SIMILAR DRAINAGE:
   01 Condensate piping: Provide flexible elastomeric cellular thermal insulation in accordance with ASTM C534/C534M. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.276 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 230 degrees F. Provide model "Armaflex Ultima", fire rated for use in environmental air plenums; insulation not required when piping is exposed on roof.
   02 Waste lines from water coolers and refrigerated drinking fountains to junction with main waste stacks: Insulate as described above.
   03 Underside of floor drains and similar receptors receiving cooling coil condensate and the tailpieces, p-traps, and the associated piping to junction with main waste stacks: Insulate as described above.

C. FACTORY-APPLIED VAPOR RETARDERS - ALL SERVICE JACKETING (ASJ+): Vapor retarder jacket for interior applications shall be composed of an aluminum foil layer, reinforced with glass scrim, bonded to a layer of white kraft paper, interleaving with an outer polymer film leaving no paper exposed; complying with ASTM C1136.

D. FIELD-APPLIED PROTECTIVE FINISHES
   01 METAL JACKETING: Provide aluminum jacketing complying with ASTM C1729 or stainless steel jacketing complying with ASTM C1767. Metal jacketing shall have a minimum thickness of 0.016 inches for piping sizes through 6” diameter, 0.020” for piping sizes 8” diameter through 10” diameter, and 0.024” for piping sizes 12” diameter through 24” diameter. Provide pre-formed fitting covers for all elbows and tees.

E. HIGH DENSITY INSERTS
   01 Provide high density inserts at all pipe support locations as indicated herein to prevent excessive compression of the insulation. High density inserts shall have a minimum compressive strength of 100 psig. Pipe supports shall either be noncombustible, or be UL listed and labeled in accordance with UL 2043. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required. Refer to 22 05 29 - Hangers and Support for Plumbing Piping and Equipment.
   02 Provide 360° high density inserts at all pipe support locations for fiberglass insulation applications. High density inserts shall be calcium silicate for fiberglass insulation applications.

03 Provide 180° high density inserts at all pipe support locations for phenolic foam insulation applications for piping 4.0” diameter or larger. High density inserts shall be phenolic foam insulation meeting the compressive strength requirements indicated herein.

04 Provide 360° high density inserts at all pipe support locations for flexible elastomeric cellular thermal insulation applications. Provide ArmaFix EcoLight or equal.

2.4 INSULATING CEMENTS

A. Mineral Fiber Insulating Cement: Comply with ASTM C195.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor and outdoor use on below ambient services. Water-Vapor Permeance shall be 0.09 perms at 55-mils dry film thickness when tested in accordance with ASTM E96/E96M, Procedure A. Service Temperature Range shall be -20 to +180 degrees F. Solids content shall be 59 percent by volume and 71 percent by weight per ASTM D1644. Provide Childers CP-35 or approved equal.

2.6 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F. Provide Childers CP-97 or approved equal.

C. Fiberglass / Glass Mineral Fiber Adhesive: Comply with MIL-DTL-3316C, Class 2, Grade A. Provide Childers CP-82 or approved equal.

D. Flexible elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I. Provide Armacell Armaflex 520 BLV or approved equal.

2.7 LAGGING ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation. Service Temperature Range shall be 0 to +180 degrees F. Provide Childers CP-52 or approved equal.

2.8 SEALANTS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Metal Jacket Flashing Sealants shall be fire and water-resistant, flexible, elastomeric sealants with a service temperature range of -40 to +250 degrees F. Provide Childers CP-76 or approved equal.

C. Fire Barrier Sealant shall be a latex-based, intumescent sealant that dries to form a monolithic firestop seal. Fire barrier sealant shall be firestop tested up to 4 hours in accordance with ASTM E814 and fire resistance tested in accordance with ASTM E1966. Provide 3M CP 25WB+ or approved equal.

2.9 GLASS FIBER FABRIC REINFORCING MESH

A. Woven Glass Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch. Provide Childers Chil-Glas No. 10 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. To ensure that external fiberglass/glass mineral fiber flexible blanket and rigid board insulation will achieve its highest possible performance and serve its intended purpose, install all mechanical insulation materials and associated accessories in accordance with manufacturer's published instructions and industry practices detailed by the NACIIS Manual as published by the Midwest Insulation Contractors Association (MICA).

B. All insulation shall be installed in accordance with the manufacturers' recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

D. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

E. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of pipe and fittings.

F. Pipes located outdoors or in tunnels or crawlspaces shall be insulated same as concealed piping and be provided with metal jacketing with longitudinal 1/2" safety hem and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. Jacket securement shall be by metal banding with clips. Banding material shall match jacketing material. Galvanized steel banding is not acceptable.

G. All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.

H. Installation of flexible elastomeric foam insulation shall be in accordance with ASTM C1710.

I. Provide all piping insulation to comply with the ASHRAE Std 90.1 I-P Minimum Thickness Schedule and as indicated below.

01 Low temperature surfaces - Minimum Insulation Thickness
- a. Interior domestic cold water pipe: 1 inch
- b. Condensate drain lines: 3/4 inch
- c. Drains receiving condensate: 1 inch

02 Domestic Hot Water and Return Piping - Minimum Insulation Thickness
- a. Pipe sizes 1-1/4 inch and smaller with operating temperatures of 140°F or less: 1 inch
- b. Pipe sizes 1-1/2 inch and larger with operating temperatures of 140°F or less: 1-1/2 inch
- c. Pipe sizes 1-1/4 inch and smaller with operating temperatures greater than 140°F: 1-1/2 inch
- d. Pipe sizes 1-1/2 inch and larger with operating temperatures greater than 140°F: 2 inch

3.2 WATER PIPE INSULATION INSTALLATION

A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 12 feet on straight runs, a vapor dam shall be formed between the vapor retarder jacket and the bare pipe. The seal shall be by the applications of vapor retarder mastic to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated fiberglass / glass mineral fiber covers finished with two brush coats of vapor retarder mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the SSL is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder mastic shall be applied to all edges of the vapor retarder jacket.

D. At hangers and supports, provide a high density insulation insert that extends 2" beyond the shield on each side and a protective shield/saddle to prevent compression/damage. Secure shield/saddle to insulation using mastic. Refer to 22 05 29 - Hangers and Support for Plumbing Piping and Equipment.

3.3 FIRE RATED ASSEMBLY PENETRATIONS

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying rock mineral fiber insulation in the annular space between the pipe and its associated sleeve.

B. Seal penetrations through fire rated assemblies with an approved fire barrier sealant. Refer to Division 7 for further requirements regarding “"Through-Penetration Firestop Systems”.

C. All fire stopping material shall be installed in accordance with manufacturer's printed instructions.

END OF SECTION

SECTION 22 10 00

PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the piping covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:
   01 Pipe and pipe fittings:
      a. Sanitary drainage piping system.
      b. Storm drainage piping system.
      c. Domestic water piping system.
   02 Adapters, Transitions, Unions, Couplings, Flanges, Connectors
   03 Valves
   04 Excavation, Bedding, and Backfill

1.3 RELATED WORK

A. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

B. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping

C. Section 22 05 53 - Identification for Plumbing Piping and Equipment

D. Section 22 07 19 - Plumbing Piping Insulation

E. Section 22 11 12 - Domestic Water Piping - Cross-Linked Polyethylene (PEX) for Institutional Facilities

F. Section 22 11 19 - Plumbing Specialties

G. Section 22 30 00 - Plumbing Equipment

H. Section 22 40 00 - Plumbing Fixtures

1.4 REFERENCES

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

B. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.

C. ASME B16.14 - Ferrous Pipe Plugs, Bushings, and Locknuts With Pipe Threads; Current Edition.

D. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2024.

E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

G. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.

H. ASME B16.24 - Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500; 2021.

I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.

J. ASME B16.39 - Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300; 2025.

K. ASME B16.50 - Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings; 2013.

L. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; Current Edition.

M. ASME BPVC - Boiler and Pressure Vessel Code; 2023.

N. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

O. ASSE 1079 - Performance Requirements for Dielectric Pipe Unions; 2012.

P. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.

Q. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).

R. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2025.

S. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings; 2022b.

T. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.

U. ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars; 2022.

V. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples; 2016 (Reapproved 2022).

W. ASTM A865/A865M - Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints; 2023.

X. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.

Y. ASTM B1 - Standard Specification for Hard-Drawn Copper Wire; 2013 (Reapproved 2018).

Z. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).

AA. ASTM B32 - Standard Specification for Solder Metal; 2020.

BB. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes; 2020.

CC. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

DD. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.

EE. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

FF. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.

GG. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.

HH. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

II. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications; 2000 (Reapproved 2015).

JJ. ASTM C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems; 2018.

KK. ASTM C1460 - Standard Specification for Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground; 2017.

LL. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.

MM. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.

NN. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

OO. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

PP. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable; 2016.

QQ. ASTM D1599 - Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings; 2018.

RR. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2020.

SS. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

TT. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings; 2022.

UU. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2025.

VV. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2024.

WW. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).

XX. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).

YY. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2024.

ZZ. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping; 2021a.

AAA. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).

BBB. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).

CCC. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.

DDD. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals; 2007.

EEE. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials; 2021.

FFF. ASTM D3311 - Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns; 2017 (Reapproved 2021).

GGG. ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials; 2017, with Editorial Revision (2019).

HHH. ASTM D4976 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials; 2012.

III. ASTM D5926 - Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems; 2015.

JJJ. ASTM D6707/D6707M - Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications; 2016.

KKK. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

LLL. ASTM E438 - Standard Specification for Glasses in Laboratory Apparatus; 1992 (Reapproved 2018).

MMM. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.

NNN. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.

OOO. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).

PPP. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.

QQQ. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings; 2021.

RRR. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings; 2019.

SSS. ASTM F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems; 2016.

TTT. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

UUU. ASTM F1548 - Standard Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications; 2001.

VVV. ASTM F1673 - Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems; 2010, with Editorial Revision (2021).

WWW. ASTM F2618 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems; 2019.

XXX. AWS A5.9/A5.9M - Welding Consumables-Wire Electrodes, Strip Electrodes, Wires, and Rods for Arc Welding of Stainless and Heat Resisting Steels- Classification; 2017.

YYY. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

ZZZ. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.

AAAA. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.

BBBB. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.

CCCC. AWWA C209 - Tape Coatings for Steel Water Pipe and Fittings; 2019.

DDDD. AWWA C219 - Bolted Sleeve-Type Couplings for Plain-End Pipe; 2023.

EEEE. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.

FFFF. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; 2020.

GGGG. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.

HHHH. AWWA C651 - Disinfecting Water Mains; 2023.

IIII. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.

JJJJ. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

KKKK. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.

LLLL. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

MMMM. NFPA 20 - Standard for the Installation of Stationary Pumps for Fire Protection; 2025.

NNNN. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2025.

OOOO. NSF 372 - Drinking Water System Components - Lead Content; 2024.

PPPP. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

QQQQ. UL 1285 - Safety Pipe and Couplings, Polyvinyl Chloride (PVC), and Oriented Polyvinyl Chloride (PVCO) for Underground Fire Service; 2016.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Valves: Manufacturer's name, size, and pressure rating shall be cast or marked on valve body or handle.

C. Piping shall be labeled along its entire length indicating size, class, material specification, manufacturer’s name and country of origin.

D. Foreign pipe, fittings or valves are unacceptable.

E. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and shall be listed by NSF International.

F. Welding Materials and Procedures: Conform to ASME BPVC and applicable state labor regulations.

G. Welders Certification: In accordance with ASME BPVC-IX.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data and video inspection report under provisions of Division One.

C. Include pipe materials, pipe fittings, valves, and accessories. Provide manufacturer's catalog information, product certifications, and country of origin. Indicate valve data and ratings.

D. Submit dimensioned detailed drawings and material specifications for pipe isolation and protection systems being provided for void form/carton form/void box installations.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of valves.

C. Include written report and digital video record of waste piping inspection.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with a minimum of 5 years documented experience and must be a domestic manufacturer.

B. Installer: Company specializing in performing the work of this section with a minimum of 5 years documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled piping and valves to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept product on site in original factory packaging. Receive valves on site in shipping containers with labeling in place. Inspect for damage. Damaged valves shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

E. Provide temporary protective coating on cast iron and steel valves.

F. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

G. Protect installed piping systems from entry of foreign materials by providing temporary covers, as completing sections of the work, and isolating parts of completed systems. Tape will not be allowed as an acceptable end cover.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

1.12 REGULATORY REQUIREMENTS

A. Perform work in accordance with plumbing and building codes having jurisdiction.

B. PVC pipe, fittings, or similar un-rated material shall not be installed in a return air plenum unless the entire length of all such piping is encased within a minimum two (2) hour fire rated enclosure.

PART 2 - PRODUCTS

2.1 SANITARY SOIL, WASTE AND VENT PIPING, BURIED BEYOND 5 FEET OUTSIDE OF BUILDING

A. PVC Pipe: ASTM D1785 / ASTM D2665 schedule 40 solid wall; installed per ASTM D2321.
   01 Fittings: PVC, ASTM D3311 / ASTM D2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
   02 Joints: solvent weld with ASTM D2564 solvent cement, installed per the requirements of ASTM D2855.

2.2 SANITARY SOIL, WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785 / ASTM D2665 schedule 40 solid wall; installed per ASTM D2321.
   01 Fittings: PVC, ASTM D3311 / ASTM D2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
   02 Joints: solvent weld with ASTM D2564 solvent cement, clear, medium bodied, for sizes 3" and smaller and gray, heavy bodied, for sizes 4" and larger. Mating surfaces shall be prepared with ASTM F656 purple primer immediately prior to cement application.

2.3 SANITARY SOIL, WASTE AND VENT PIPING, WITHIN BUILDING, NOT BURIED

A. Cast Iron Pipe: CISPI 301 or ASTM A888, hubless.
   01 Fittings: Cast iron, CISPI 301 or ASTM A888 drainage pattern.
   02 Acceptable manufacturers (all pipe and fittings shall be from a single manufacturer):
      a. Tyler Pipe
      b. Charlotte Pipe
      c. AB&I Foundry
   03 Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.
   04 Joints: No hub heavy-duty, shielded, stainless steel couplings meeting ASTM C1540 and FM 1680 Class 1. Complete with minimum 304 stainless steel bands, tightening devices, and shield (minimum 0.015 shield thickness). ASTM C564 neoprene gasket. Made in the USA. Torque all clamps per manufacturer's recommendations. Acceptable manufacturers:

a. Husky SD 4000
b. Clamp-All 125

2.4 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785 / ASTM D2665 schedule 40 solid wall; installed per ASTM D2321.
01 Fittings: PVC, ASTM D3311 / ASTM D2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
02 Joints: solvent weld with ASTM D2564 solvent cement, installed per the requirements of ASTM D2855.

2.5 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET OUTSIDE OF BUILDING

A. Copper Tubing: ASTM B88, Type K, hard drawn.
01 Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper alloy solder joint pressure fittings.
02 Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy HB lead-free solder.
03 Provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines, for all buried piping. Chase Construction Products Tapecoat H35 or approved equivalent.

2.6 DOMESTIC WATER PIPE, BURIED WITHIN 5 FEET OF BUILDING EDGE

A. Stainless Steel Pre-Fabricated In-Building Riser (acceptable for sizes 2" through 10")
01 Corrosion resistant Type 304 stainless steel construction single, extended 90 degree fitting.
02 UL listed, FM approved and NFPA 24 compliant.
03 Lead free and NSF 61 / NSF 372 certified.
04 Acceptable manufacturers:
a. Ames Fire & Waterworks Series IBR (4" through 10") and IBR2 (2", 2-1/2", and 3")
b. Zurn Wilkins Model WBR (4" through 10")
05 For sizes 3" and smaller, ensure to provide riser with an (inlet) end connection type as appropriate for the site water service pipe material. Provide an adapter fitting at each end of the riser if/as necessary. All such fittings shall be approved for installation with the piping material being installed, code accepted, and NSF 61 compliant.
06 Note: For this application, the inlet joint for larger diameter (4" through 10") piping (which shall not be located below a building slab or foundation) can be rubber gasketed push-on type, ANSI/AWWA C111/A21.11. Installation shall be in accordance with AWWA C600.
07 Provide continuous polyethylene encasement for all piping buried or in contact with concrete in accordance with AWWA C105/A21.5, beginning at no closer than the 5'-0" mark from the building and to a minimum of 6" above the finished floor.

2.7 DOMESTIC WATER PIPING, WITHIN BUILDING, BURIED

A. Copper Tubing: ASTM B88, Type K, soft annealed.
01 No joints allowed buried, run tubing continuous.
02 Provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines, for all piping buried or in contact with concrete, to a minimum of 6" above finished floor. Chase Construction Products Tapecoat H35 or approved equivalent.

03 Applies to installations including services to island sinks and trap primer lines.
04 Also provide protection from concrete for copper piping at penetrations through elevated decks.

2.8 DOMESTIC WATER PIPING, WITHIN BUILDING, NOT BURIED

A. Copper Tubing: ASTM B88, Type L, hard drawn.
01 Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper alloy solder joint pressure fittings.
02 Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy HB lead-free solder.
03 Fittings and joints for pipe sizes 1/2" through 4” may be mechanical press-connect system joints with ASME B16.51 lead-free copper bodied fittings with integral ethylene-propylene diene monomer rubber (EPDM) sealing gaskets. All fittings, couplings, and adapters shall be the product of a single system manufacturer and only that manufacturer’s approved press tools, kits, and jaws shall be used.
a. EPDM o-rings shall be pre-installed and lubricated with NSF 61 listed lubricant.
b. All installers of copper press-connect fittings shall be trained by the fitting manufacturer’s appointed representative and carry such credentials for the duration of the project.
c. The fitting manufacturer’s representative shall conduct periodic inspections of the installation and shall provide written reports of such inspections to the Contractor and Engineer, including any observed deviations from the manufacturer’s recommended installation practices.
d. Acceptable system manufacturers: Viega Pro-Press only.
04 Rolled groove type fittings and joints shall be acceptable for copper pipe sizes 2-1/2 inch and larger, with all tools, couplings, adapters, fittings, and gaskets the product of a single system manufacturer.
a. Fittings shall be cast bronze using lead-free alloys per ASTM B584 or copper wrought copper constructed to ASTM B75/B75M, compliant with NSF 61 for potable water service applications, and meet ASTM F1548.
b. Couplings shall be epoxy/enamel (rust-inhibiting) coated ductile iron housings conforming to ASTM A536.
c. Gaskets shall be EPDM for potable water, meeting ASTM F1476, and NSF 61 / NSF 372 certified for potable water service from 30 degrees to 180 degrees F.
d. Acceptable system manufacturers: Victaulic, Shurjoint, Anvil Gruvlok.

2.9 ADAPTERS, TRANSITIONS, UNIONS, COUPLINGS, FLANGES, CONNECTORS

A. (Non-Acid Waste) Drainage Applications:
01 Provide approved listed adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements.
02 Not buried: For dissimilar piping not buried, provide stainless steel shielded, molded elastomeric couplings and adapters meeting ASTM C564 and ASTM C1460. Applies to installations including cast iron to PVC transitions immediately adjacent to the building floor where piping below is buried.
a. Husky 4200 or Cremco
b. Fernco Proflex

03 Buried, but NOT below building slab: For dissimilar buried piping beyond the limits of building or readily accessible buried piping transitions in backwater valve pits, etc. Provide shear resistant .012" thick 300 series stainless steel shielded, PVC gasketed flexible couplings and adapters meeting ASTM D5926 and ASTM C1173. For direct-bury applications, provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines, to completely wrap the shield, banding, and screws. Chase Construction Products Tapecoat H35 or approved equivalent.
   a. Cremco
   b. Mission Rubber Company, LLC
   c. Fernco, Inc. Strong Back RC 1000 Series

04 Adapters, couplings, bushings for copper DWV pipe shall be cast bronze or wrought copper, ASME B16.23 / ASME B16.29.

B. Domestic Water Applications:

01 Provide joints between various materials with approved adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements and the manufacturer's instructions.

02 For copper tube and pipe: adapters, bushings, plugs, caps, and couplings shall be wrought copper or cast bronze; flanges (minimum class 150) and unions shall be cast bronze. Provide with solder or threaded connections as necessary and as produced to applicable standards ASME B16.15, ASME B16.18, ASME B16.22, ASME B16.24, ASME B16.50 ASME B16.50, ASME B1.20.1. All such appurtenances shall be for use in above ground potable water systems.

03 Buried to not buried transitions for water service entries:
   a. 100% fusion bonded epoxy coated ASTM A536 cast ductile iron construction coupling with acrylonitrile butadiene rubber (NBR) gaskets and EPDM insulating boot for water service. 5/8 inch high strength stainless steel bolts and nuts. Coupling shall meet AWWA C219. Romac Industries, Inc. IC501 or pre-approved equivalent.
   b. 100% fusion bonded 14 mil epoxy coated coupling with ASTM A536 cast ductile iron rings. Complete with acrylonitrile butadiene rubber (NBR) gaskets and type 304 stainless steel bridge, spacers, nuts, and bolts. Coupling shall meet AWWA C219, NSF 61, and NSF 372. Krausz USA Hymax Grip Coupling Restraint or pre-approved equivalent.

04 Dielectric connections:
   a. For pipe sizes 2 inch and smaller, provide lead-free dielectric unions, rated to 180 F at 250 psi and compliant to ASSE 1079.
   b. For pipe sizes larger than 2 inches, provide lead-free dielectric flanged pipe fittings, rated to 180 F at 175 psi and meeting ASME B16.1.
   c. For grooved copper joining systems, provide grooved end dielectric transition fitting from system manufacturer, with virgin polypropylene internal lining, meeting NSF 61.

C. General:

01 Unions for ferrous pipe shall be ASME B16.39 galvanized malleable iron, threaded, minimum pressure class 150.

02 Plugs and bushings for ferrous pipe shall be ASME B16.14 galvanized malleable iron, threaded.

03 Nipples for ferrous pipe shall be schedule 40, galvanized, ASTM A53/A53M welded steel pipe nipples, threaded, meeting ASTM A733.

04 Couplings for ferrous pipe shall be galvanized steel, threaded, manufactured in accordance with ASTM A865/A865M.

05 Flanges for ferrous pipe shall be galvanized forged steel construction, either socket weld or slip-on weld type, minimum pressure class 150, manufactured to ASME B16.5.

06 Bolts, nuts, and gaskets for flanged connections shall be appropriate to the pipe material, fluid type, temperature, and pressure. 1/16" thick pre-formed neoprene, typical.

07 Provide flexible stainless steel connectors at pumps and other such equipment, in accordance with manufacturer's recommendations. Connectors shall have corrugated hose and braided 300 series stainless steel jacketing. Carbon steel flanged or grooved ends as appropriate. NSF 372 lead-free for all potable water applications. Metraflex Company or pre-approved equivalent.

2.10 BALL VALVES

A. All bronze cast construction two-piece 600 psi body, blow-out proof stem, Teflon seated, lead-free, with stainless steel trim (including ball, stem, and valve handle). Threaded connections. Certified lead-free to NSF 61 / NSF 372 and suited to 180 degrees F.

B. Basis of design (bronze valves):
   01 NIBCO T-585-66-LF (full port) for all sizes up through 2".
   02 NIBCO T-580-66-LF (conventional port) for sizes 2-1/2" and 3".

C. Valves 4" and larger shall be split body stainless steel construction, 275 psi cold working pressure, blow-out proof stem, PTFE seated, type 316 stainless steel trimmed, class 150, full port design with manual gear operator. NIBCO F-515-S6-F-66-FS.

D. Acceptable alternate manufacturers:
   01 Apollo 77 CLF-A series (full port) for all sizes up through 2".
   02 Milwaukee UPBA-400S (full port) for all sizes up through 2".
   03 Apollo 77 CLF-A series (full port) for size 2-1/2" and Apollo 70LF-140 series (standard port) for 3".
   04 Milwaukee UPBA-100S (standard port) for sizes 2-1/2" and 3".

E. Applies to domestic water system installations.

F. Provide valves complete with extended lever handles as required to accommodate insulation and full valve operation.

G. Provide valves complete with memory stop kit where used for balancing applications.

2.11 CHECK VALVES (BRONZE)

A. ASTM B62 / ASTM B584 bronze body and disc, minimum 200 psi (cold working pressure) Y-pattern horizontal swing type check valve with removable bronze bonnet, Type 300 series stainless steel nuts and hinge pin, and PTFE disc seat. Threaded connections. Certified lead-free to NSF 61 / NSF 372 and suited to 180 degrees F.

B. ASTM A126 cast iron bodied, (minimum) class 125 globe style spring loaded (silent) check valve with ASTM B584 bronze disc and seat. Flanged connections. Certified lead-free to NSF 61 / NSF 372 and suited to 200 degrees F.

C. Basis of design:
   01 NIBCO T-413-Y-LF (Y-pattern swing type) for sizes up through 2".
   02 NIBCO F-910-B-LF (globe style spring loaded type) for sizes 2-1/2" and larger.

D. Acceptable alternate manufacturers:
   01 Apollo (for sizes up through 2”)

E. Applies to domestic water system installations including associated pump discharge lines. Valves shall be suited for installation in both horizontal lines and vertical lines with upward flow, in accordance with manufacturer’s recommendations.

2.12 CHECK VALVES (IRON)

A. ASTM A126 cast iron bodied, (minimum) class 125 conventional horizontal swing type check valve with bronze, cast or ductile iron disc. 200 psi cold working pressure. Threaded or flanged connections.

B. Basis of design:
   01 NIBCO T-918-B (threaded connections) for sizes 2” through 4”.
   02 NIBCO F-918-B (flanged connections) for sizes 6” and larger.

C. Acceptable alternate manufacturers:
   01 Apollo (flanged in all sizes)
   02 Milwaukee F-2974A (flanged in all sizes)

D. Applies only to limited installations such as services from submersible pumps and ejectors. Not to be used for domestic water systems.

2.13 BALANCING VALVES

A. Self-contained, fully automatic thermally actuated balancing valve shall continuously adjust flow to maintain the desired domestic hot water temperature within the branch line, regardless of system operating pressure. Valve shall modulate between open and closed position within a 10 degrees F range. The valve set-point (closing temperature) shall be the hot water system supply temperature. Valve body and all internal components shall be constructed of stainless steel with major components constructed of Type 303 stainless. Rated for 200 psi maximum working pressure and no less than 250 degrees F maximum working temperature. Lead-free NSF 372 and NSF 61 compliant. Threaded connections.

B. Basis of design:
   01 ThermOmegaTech Circuit Solver, sizes 1/2" through 2”. Provide a union and ball type shutoff valve on both sides of the balancing valve.
   02 ThermOmegaTech Circuit Solver with integrated union (CSU) assembly, sizes 1/2" and 3/4". Balancing valve assembly shall come complete with union body and ball type shutoff valves on both sides.
   03 Provide complete with an integral check valve from the manufacturer, positioned after the balancing valve. For balancing valves not available with an integral check valve as part of the manufacturer's assembly, ensure to provide a lead-free swing type check valve on the downstream side of the balancing valve component.

C. Applies to circulated domestic hot water system installations including multi-branch parallel piping circuits and single-loop piping circuits.
   01 Provide balancing valve at end of each domestic hot water supply line (after last fixture served) just prior to the hot water return line, as indicated on Drawings and in accordance with manufacturer’s installation recommendations.

02 Provide a pipe tee or elbow with bushing as appropriate, 3/4" threaded thermowell, and bi-metal adjustable angle 3 inch dial thermometer upstream of each balancing valve. Thermowell stem length and thermometer temperature probe length to be suited for pipe size, insulation thickness, and to ensure clearance for maintenance access and easy viewing of thermometer. Trerice bimetal/sensor, threaded-stepped shank thermowell (style 76) of lead-free brass (PBF) material. Trerice Model B836 thermometer with 300 stainless steel case and stem, hermetically sealed, double strength glass windowed, aluminum white-faced dial, complete with external reset and 0 to 200 degrees F range. Thermowell and thermometer face to be oriented upright for readability.

PART 3 - EXECUTION

3.1 EXCAVATION, BEDDING AND BACKFILL

A. This section shall apply for the excavation, bedding, and backfill of all buried piping unless specifically noted otherwise. All work shall be coordinated with any job site subsurface drainage/dewatering and adjusted accordingly.

B. Establish elevations of buried piping outside the building to ensure the following:
   01 Not less than 2 feet of cover, or not less than maximum depth of frost penetration, whichever is the greater.
   02 For water lines intended for fire protection service, the depth of cover shall be:
      a. Not less than 2’-6” in those locations where frost is not a factor.
      b. Not less than 1’-0” below the frost line for the locality.
      c. Not less than 3’-0” for piping under driveways.
      d. Not less than 1’-0” below the bottom of the building foundation/footers.
      e. In full compliance with the requirements of NFPA 13 and NFPA 24.

C. Excavation:
   01 Excavate trenches for underground piping to the required depths.
   02 The bottom of the trench or excavation shall be cut to a uniform grade.
   03 Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp to existing density.
   04 Coordinate alignment of pipe trenches to avoid obstructions. Ensure that proposed routing of pipe will not interfere with building foundation before any trenching has begun. Should conflicts occur, contact Architect/Engineer before proceeding.
   05 Should any sleeving of the building foundation be required, this shall be provided as directed by the structural engineer of record AND in accordance with the prevailing code, but in no case shall the sleeve be any less than two (2) pipe sizes larger than the pipe it serves.

D. Bedding and Backfill:
   01 Backfill shall not be placed until the piping has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades indicated on drawings.
      a. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe.
      b. Provide select fill up to finished surface or grade, unless indicated otherwise by project geotechnical report or specified otherwise in Division 02.
      c. In lieu of cement stabilized sand, pea gravel may be used for the bedding and cover described above. Pea gravel shall be clean, well graded, fine gravel (per ASTM D2487) with an approximate top size of 3/8".
   02 Compacting Backfill: Place material in uniform layers of 8 inches maximum, loose measure and compact to not less than 95% of maximum soil density as determined by ASTM D698 Standard Proctor.

03 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.

04 A clay fill “trench plug” extending 3 feet inside the building line and 5 feet outside the building line shall be placed to completely surround utility lines passing beneath the foundation and grade beam. The materials shall consist of on-site soils with a plasticity index (PI) between 30 and 40 percent compacted to at least 95 percent of the Standard Proctor and maximum dry density as determined by ASTM D698.

E. Cement Stabilized Sand:

01 Materials:

a. Cement shall be Type I Portland cement conforming to ASTM C150/C150M.

b. Sand shall be clean, durable sand meeting grading requirements for fine aggregates of ASTM C33/C33M and free of organic matter and deleterious substances.

c. Water shall be potable and free of oils, acids, alkalis, organic matter, or other deleterious substances, meeting requirements of ASTM C94/C94M.

02 Mixture:

a. Product shall consist of not less than 1.5 sacks of Portland cement per ton of dry sand.

b. Mixture shall contain sufficient water to hydrate the cement and be thoroughly mixed in a pugmill type mixer.

F. For water lines (including In-Building Risers) intended for fire protection service, provide joint restraints by way of concrete thrust blocks in accordance with the requirements of NFPA 13 and NFPA 24.

G. Aggressive Soil Conditions: Soil shall be considered aggressive and protection of buried metallic piping shall be provided as specified if any of the following situations exist:

01 Conditions are identified as such by the project geotechnical report or project geotechnical engineer.

02 The soil environment is a landfill area, swamp, marsh, polluted river bottom, cinder bed, or has alkaline soils.

03 A score of ten or higher is tallied when applying the soil assessment tool detailed in Appendix A of AWWA C105/A21.5. An excerpt of this evaluation procedure is provided below for reference but is not intended as a substitute for the complete and latest Standard:

NUMERICAL CORROSIVITY SCALE	
Soil Parameter	**Assigned Points**
Resistivity (ohm-cm)	
< 700	10
700 - 1,000	8
1,000 - 1,200	5
1,200 - 1,500	2
1,500 - 2,000	1
> 2,000	0
pH	
0 - 2	5
2 - 4	3
4 - 6.5	0
6.5 - 7.5	0
7.5 - 8.5	0
> 8.5	3
Redox Potential (mV)	
> 100	0
50 - 100	3.5
0 - 50	4
< 0	5
Sulfides	
Positive	3.5
Trace	2
Negative	0
Moisture	
Poor drainage continuously wet	2
Fair drainage generally moist	1
Good drainage generally dry	0

H. Pipe Penetrations of Buried Exterior Walls or Foundations

01 Unless specifically indicated otherwise on the Drawings, each pipe penetration shall be provided with a schedule 40 steel pipe sleeve no less than two (2) pipe sizes larger than pipe itself.

02 At each penetration provide GPT Industries (“Thunderline”) Link Seal Modular Seal LS series. The exact model shall be as required for the pipe material, pipe size, and sleeve length for the penetration. Provide complete with EPDM sealing element and model “C” zinc coated carbon steel hardware.

3.2 INSTALLATION

A. General requirements for piping:

01 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

02 Remove any scale, oil and dirt, on inside and outside, before assembly.

03 Prepare piping connections to equipment with flanges or unions.
04 Confirm pipe placement, depth/elevation, and flow lines prior to any installation.
05 For gravity drainage applications, double combination wye and eighth bend fittings shalll not be installed in a horizontal to horizontal orientation.

B. General requirements for valves:
01 Install valves with stems upright or horizontal, not inverted.
02 Valves shall be line-sized unless specifically noted otherwise.
03 Provide clearance for installation of insulation and access to valves and operable fittings. Valves installed beyond reasonable reach shall be provided with a chain operator.
04 Provide access doors where valves and operable fittings are not otherwise accessible. Access doors shall be of approved types set in locations pre-approved by submittal to the Architect.
05 Gate valves installed buried shall be covered with an adjustable cast iron roadway box extended to grade. Cover shall be cast iron with 'water' cast on top of cover and shall be set flush to finished paving or 2" above finished earthen grade. Box shall be supported from undisturbed soil or concrete base and shall not introduce any stress to piping under all traffic conditions.

C. Install all materials in accordance with the manufacturer's published instructions.

D. Unburied piping inside the building shall be installed concealed, out of public view wherever possible (above ceilings, inside walls and chases, within casework, etc.). This requirement shall not apply to fixture supplies & stops and chrome plated tubular brass drainage piping.

E. All exposed sewer and water pipe in toilet rooms or other finished areas of the building shall be chrome plated.

F. Provide non-conducting dielectric connections wherever joining dissimilar metals.

G. Route piping in an orderly manner, parallel and perpendicular to building column grid lines, unless indicated otherwise on drawings, and maintain gradients.

H. Install piping to conserve building space and not conflict with other trades or interfere with intended use of space.

I. Group piping whenever practical at common elevations.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

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. Provide encasement for and support for utility meters in accordance with the requirements of utility companies.

M. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.

N. Maintain uniformity in the installation of piping materials and joining methods. Do not mix material types.

O. Where connecting new underground sanitary, storm, or vent piping to existing piping of dissimilar material, provide suitable mechanical transition fittings complete with corrosion protection for metallic elements. Chase Construction Products Tapecoat H35 or approved equivalent and a final coat of coal tar to completely cover the transition.

P. Solder joints shall be wiped clean at each joint, remove excess metal while molten and flux residue when cooled.

Q. Waste nipple from wall to tapped tee shall be schedule 40 threaded galvanized steel pipe or brass or copper with threaded adapter.

R. General requirements for cast iron piping installation:
   01 Install all pipe and fittings in accordance with published recommendations from the manufacturer and the Cast Iron Soil Pipe Institute (CISPI). Specific items referenced below are not intended as a substitute for the complete and latest recommendations.
   02 Install bell and spigot type pipe with bell end upstream.
   03 Above ground horizontal pipe (suspended) shall:
      a. Be supported at no less than at every joint, and within 18” of the hub or coupling.
      b. Be maintained in alignment. Sagging or grade reversal shall be unacceptable.
      c. Be supported at terminal ends of all runs or branches and at each change of direction or alignment.
      d. Have all closet bends, traps, trap arms, and similar branches firmly secured.
      e. Be braced to prevent movement or joint separation.
      f. Be provided with suitable sway bracing (such as clamps, rods, and hardware) where pipe and fittings are suspended in excess of 18” by means of non-rigid hangers.
   04 Above ground vertical pipe shall:
      a. Be secured at each stack base.
      b. Be secured at each floor and riser clamps shall be provided on no greater than 15’-0” intervals.
      c. Be adequately supported to keep the system (pipe and contents) in alignment.
   05 Provide seismic restraints in seismically active areas, whether specifically required by the prevailing code or not.

S. For all buried non-metallic piping outside the building, provide minimum 14 AWG solid copper tracer wire (ASTM B1, ASTM B3) with high molecular weight polyethylene insulation (HMWPE) per ASTM D1248. Wire shall be suited for direct bury applications to facilitate the detection and tracing of underground piping systems. THHN wire and other such nylon jacketing shall not be allowed. Insulation color shall be provided per the particular utility, in accordance with the American Public Works Association (APWA) uniform color code. Provide corrosion proof wire connectors with twist locking design and protective dielectric sealant. Copperhead Industries, LLC Snakebite or pre-approved equivalent. Tracer wire shall be placed in the same orientation as the installed pipe and laid six inches directly above the piping. One end of the tracer wire shall be brought aboveground at a building wall or riser for easy identification.

T. PVC pipe, fittings, or similar un-rated material shall not be installed in a return air plenum unless the entire length of all such piping is encased within a minimum two (2) hour fire rated enclosure.

U. Installations of buried thermoplastic piping systems shall be in strict conformity with the manufacturer's published instructions and the requirements of ASTM D2321 (gravity pipe) and ASTM D2774 (pressure pipe).

V. Installation of thermoplastic piping systems which are not buried shall be in accordance with the manufacturer's recommendations. The specific items indicated below are not intended as a substitute for the complete and latest manufacturer's recommendations.

01 Hangers and supports shall not compress, distort, cut, or abrade the piping. Nor shall they force the pipe and fittings into position.

02 Piping shall be supported at intervals sufficiently close to maintain pipe alignment and to prevent any sagging or grade reversal. System maximum operating temperature will determine support spacing.

03 Piping shall be supported at all branch ends and at all changes of direction, as close as practical to the fitting to avoid introducing excessive torsional stresses into the system.

04 Directly support (or if need be, immediately adjacent to) concentrated loads in the system, such as valves and other appurtenances.

05 Allowances must be made for thermal expansion and contraction of the piping system where temperature fluctuations can reasonably be expected to produce such movement. Provide and place hangers accordingly so as not to restrict.

06 Plastic piping systems shall not be placed alongside steam or other high temperature pipe lines or other high temperature objects.

07 Drainage piping shall be supported at trap arms as close as possible to the trap and all closet bends shall be supported and braced.

W. Installation of solvent cement joints for PVC and CPVC piping shall be in strict conformity with the requirements of ASTM D2855 and manufacturer's published instructions.

X. Provide approved heavy duty transition coupling at each transition from cast iron pipe not buried to buried PVC pipe as specified elsewhere in this section. Transition shall be made as close as possible to the floor for sanitary DWV piping systems and at test tee "minimum 12 inches A.F.F." for storm drainage piping. Support vertical cast iron pipe from floor anchors using riser clamp and galvanized all thread rod as specified in Section 22 05 29.

Y. All grooved system tools and components (couplings, adapters, fittings, gaskets, and specialties) shall be the product of a single domestic system manufacturer.

Z. Grooved pipe system manufacturer shall provide on-site training for contractor's field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products at no additional cost to the owner.

3.3 APPLICATION

A. Provide union downstream of all valves at equipment or apparatus connections.

B. Provide unions downstream of all threaded isolation valves in the domestic water system to facilitate any future valve replacement.

C. Provide male adapters each side of threaded valves in copper piped system. Sweat solder adapters to tube prior to make-up of threaded connections.

D. Provide approved isolation valves for shut-off and to isolate all equipment items and distinct parts of systems. Isolation valves shall be provided for both hot and cold water in locations including, but not necessarily limited to, the following:
   01 At the domestic water service entry.
   02 At each wing of the building.
   03 At each floor for each domestic water tap branching off from a vertical riser.
   04 At each domestic water branch line capped for future use.
   05 At each restroom or restroom group.
   06 At each hose bibb, wall hydrant, roof hydrant, hose reel, and trap primer device (except for flush valve or tailpiece type trap primer devices).
   07 At each domestic water branch line within 24” of the corresponding main.
   08 At each plumbing fixture not otherwise served by a localized fixture group isolation valve.
   09 At each kitchen or similar food service space.

E. Each plumbing water rough-in stub out shall be fitted with a supply stop.

F. Valves installed in insulated piping shall be fitted with extended lever operators of sufficient length to raise handle above the insulation jacket material. Where valve is used for throttling service, the valve handle shall be equipped with adjustable memory stop device.

G. Provide non-slam type check valves on discharge lines from all water pumps. Install at a minimum length of 5 times the pipe diameter from the pump and in accordance with manufacturer’s installation recommendations.

3.4 ERECTION TOLERANCES

A. All gravity drainage piping shall be provided at a uniform and continuous slope in accordance with the prevailing plumbing code and as described below. If any of the criteria below conflicts with the prevailing code then the code requirements shall govern:
   01 Gravity piping 3" and smaller shall be provided at no less than 1/4" per foot slope.
   02 Gravity piping 4" and larger shall be provided at no less than 1/8" per foot slope.
   03 Where the code allows for a shallower slope than indicated above, this shall be allowed if required per project conditions.
   04 Where the code requires a steeper slope than inidcated above (such as for grease waste piping) than such requirements shall control.

B. All vent and branch vent pipes shall be graded and connected as to drip back by gravity to the drainage pipe it serves. A slope of 1 inch per 40 feet will suffice for this requirement, subject to the approval of the local Authority Having Jurisdiction.

C. Slope all horizontal water piping with uniform pitch of 1/8 inch per 10 feet to low points to allow for complete system drainage. For long runs, where constant pitch cannot be maintained, provide intermediate low points and rise up again from such locations. Slope horizontal branches back to mains or risers. Provide clearly identified supplementary drain valves where hose bibbs, hydrants, or sill cocks will not suffice for this requirement.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, all domestic water systems shall be complete, thoroughly flushed clean and free of all foreign matter or erection residue.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. On building side of the main shut off valve, provide a 3/4" connection through which chlorine can be introduced into the water piping

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, in sufficient quantity to obtain 50 to 80 mg/L residual free chlorine solution throughout the entire domestic water piping systems.

E. Bleed water from outlets as required to ensure complete distribution and test for disinfectant residual at a minimum 15 percent of total outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.6 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services connecting to existing building services or utility lines as shown on the drawings.

B. Before commencing work, field verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover as required.

C. Provide new domestic water service connecting to existing building services or utility lines as shown on plans. Assure connections are in compliance with requirements of the jurisdiction having authority.

D. Extension of services to the building shall be fabricated from the same materials as the utility service lines or those materials specified herein.

E. Should points of connection vary from those indicated on the drawings contractor shall properly allow for this in the actual connections field fabricated.

3.7 RODDING SEWERS

A. All sanitary soil and waste 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.

3.8 VIDEO INSPECTION AND DOCUMENTATION

A. It shall be the responsibility of the plumbing contractor to retain the services of a qualified, independent company (other than the installing plumbing contractor) with no less than ten (10) years of experience in digital video camera inspection/investigation of plumbing drainage waste and vent lines for commercial/institutional building projects.

B. The independent company shall perform a complete video camera inspection of all waste piping buried inside the building. This shall include sanitary waste and any specialty waste (grease waste, oily waste, etc.) systems and shall extend from the building all the way to any associated outdoor traps/interceptors.

C. The independent company shall create a permanent digital video record of their inspection with accompanying definitive identification (audio or visual) to indicate different systems and different areas of the systems inspected.

D. The independent company shall prepare a comprehensive written report including, but not necessarily limited to, the following:
   01 Complete company contact information.
   02 Project name and address.
   03 Date(s), time(s), and conditions during the inspection(s).
   04 Name(s) of the operator(s) performing the inspection(s).
   05 A general summary of the inspection results.
   06 A written description of any and all material and/or installation deficiencies or irregularities found, with accompanying pictorial documentation. This shall include conditions such as:
      a. Deformed or damaged piping
      b. Full or partial blockage of piping
      c. Deleterious material or debris within the piping
      d. Slope deficiencies (inadequate, inconsistent, or absent slope)
      e. Valleys or “dips” in the piping
      f. Improper fittings in the piping including reductions in pipe size in the direction of flow

E. The written report shall be submitted under this Section but separately from other submittals of this Section. This shall occur immediately prior to substantial completion.

F. The written report and the digital video record (DVD or USB flash drive) shall also be submitted as part of the Project Record Documents.

3.9 TESTING OF PLUMBING PIPING SYSTEMS

A. During the progress of the work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Architect. The Architect or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems testing shall be accomplished prior to the application of insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 24 hours. Tests shall be witnessed by the Architect or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

G. Domestic Water: Pressure test at one and one half times the normal working pressure or 125 psig, whichever is the greater, for 24 hours.

H. Sanitary Soil, Waste and Vents and Storm Sewer:

01 After the rough-in soil, waste and vent and other parts of the sanitary sewer including branch laterals have been set from the lowest level, at point of connection to existing utility lines, to above the floor line, all outlets shall be temporarily plugged or capped, except as are required for testing as described herein. Ground work shall not permit the backfill of trenches to cover any joints until the completion of testing. Back fill shall be limited to mid sections of full joints of piping only. For pipe in ground the piping shall be readied as described herein and filled with water to a verifiable and visible level to 10' above the lowest portions of the system being tested.

02 On multi-level buildings only one floor level shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.

03 Should the completion of these tests leave any reasonable question or doubt of the integrity of the installation, additional tests including peppermint smoke, or other measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

3.10 COMPLETE FUNCTIONING OF WORK

A. All work reasonably implied as essential to the complete functioning of the systems shown on the Drawings and Specification shall be completed as part of the work of this Division, unless specifically stated otherwise. It is the intention of the Drawings and Specification to establish the type and function of systems but not to set forth each item essential to the functioning of any system. In case of doubt as to the work intended or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for Supplementary Instructions and Drawings, etc.

END OF SECTION

SECTION 22 11 19

PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the specialties covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:

01 Hose Bibbs and Hydrants
02 Backflow Preventers
03 Water Hammer Arresters
04 Thermostatic Mixing Valves
05 Floor Drains and Floor Sinks
06 Cleanouts
07 Trap Primers
08 Interceptors and Separators

1.3 RELATED WORK

A. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

B. Section 22 10 00 - Plumbing Piping

C. Section 22 30 00 - Plumbing Equipment

D. Section 22 40 00 - Plumbing Fixtures

1.4 REFERENCES

A. ASME A112.6.3 - Floor Drains; 2022.

B. ASME A112.1070 - Performance requirements for water temperature limiting devices; 2020.

C. ASSE 1010 - Performance Requirements for Water Hammer Arresters; 2004.

D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.

E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.

F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.

G. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies; 2021.

H. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.

I. ASSE 1060 - Performance Requirements for Outdoor Enclosures for Fluid Conveying Components; 2017 (Reaffirmed 2021).

J. ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves; 2020.

K. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.

L. ASSE 1071 - Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment; 2012.

M. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. NSF 372 - Drinking Water System Components - Lead Content; 2024.

P. PDI-WH 201 - Water Hammer Arresters; 2017.

Q. ASME A112.6.7 - Sanitary Floor Sinks

R. ASSE 1057 - Performance Requirements for Freeze Resistant Sanitary Yard Hydrants with Backflow Protection

S. ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves

T. AWWA C510 - Standard for Double Check Valve Backflow Prevention Assembly

U. NSF 61 - Drinking Water System Components - Health Effects

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit shop drawings and product data under provisions of Division One.

C. Include component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of equipment and backflow preventers.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Operation Data: Indicate frequency of treatment required for interceptors and separators.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two loose keys for hose bibbs and hydrants and spare hose end vacuum breakers.

1.11 REGULATORY REQUIREMENTS

A. Conform to applicable codes for the provision and installation of all required backflow prevention devices.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

C. Provide backflow prevention assembly test and maintenance report for all devices. A printed and signed form by the licensed tester that performed the work shall be provided both to the Owner and to the Public Water System in accordance with TCEQ (Texas Commission on Environmental Quality) requirements.

PART 2 - PRODUCTS

2.1 HOSE BIBBS/HYDRANTS

A. General: Provide an operating handle for each loose keyed device on the project.

B. Hose Bibb: Bronze or brass construction, replaceable stem assembly, hose thread spout, complete with vandal resistant lockshield and ASSE 1011 integral vacuum breaker. Provide chrome plated and with removable key where exposed in public areas.

C. Wall Hydrant: Bronze or brass construction, replaceable stem assembly, hose thread spout, non-freeze, self-draining type with integral vacuum breaker. ASSE 1019. Unless specifically noted otherwise, provide recessed complete with heavy cast aluminum or nickel plated brass lockable box and loose key operator.

D. ACCEPTABLE MANUFACTURERS:
   01 J.R. Smith
   02 Zurn
   03 Mifab
   04 Watts
   05 Wade
   06 Chicago (interior use hose bibbs only)
   07 Woodford
   08 Prier

2.2 BACKFLOW PREVENTERS

A. General Requirements: All assemblies shall be suited for the system anticipated working pressure and temperature as well as the intended orientation (vertical or horizontal) of the installation. All assemblies shall be lead-free per NSF 372, unless specifically noted otherwise on the Drawings.

B. Strainer Requirements: Lead-free compliant strainers shall be provided at all backflow preventers on the upstream side of each assembly. Strainer bodies shall be either bronze/cast copper alloy or of cast iron/ductile iron construction with an FDA approved epoxy coating. Screens and internal components shall be stainless steel.

C. Reduced Pressure Backflow Preventers: ASSE 1013; Bronze or FDA approved epoxy coated cast iron body with corrosion resistant internal parts and stainless steel springs; two independently operating, spring loaded check valves; intermediate internal pressure intermediate relief valve with water outlet; test cocks and isolation valves.

D. Double Check Valve Assemblies: ASSE 1015; Cast copper alloy or FDA approved epoxy coated cast iron body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves, test cocks and isolation valves.

E. Dual Check Valve with Intermediate Atmospheric Vent: ASSE 1012; Brass body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

F. ACCEPTABLE MANUFACTURERS:
   01 Watts
   02 Wilkins
   03 Ames
   04 Febco
   05 Conbraco

2.3 WATER HAMMER ARRESTERS

A. Engineered water hammer arresters: ASSE 1010 listed, lead-free, pre-charged, permanently sealed, maintenance- free, suited for concealed installation, with a working temperature range of 33 to no less than 212 degrees F and a maximum working pressure of no less than 250 psi during pressure surges. Stainless steel or copper body construction. Shall be sized and located in accordance with Plumbing Drainage Institute standard PDI-WH 201.

B. ACCEPTABLE MANUFACTURERS:
   01 J.R. Smith
   02 Zurn
   03 Mifab
   04 Wade
   05 P.P.P.

2.4 THERMOSTATIC MIXING VALVES

A. Provide thermostatic mixing valves in accordance with manufacturer's recommendations and as indicated and scheduled on Drawings.
   01 Unless scheduled otherwise, all units other than under-counter point of use units shall be provided complete in lockable cabinet of 16 gage (1.5 mm) prime coated steel when located in finished areas.
   02 All under-counter point of use units shall be provided complete with integral checks and dual stainless steel strainers on inlets for protection against fouling.

B. Types and Requirements:
   01 Where hot and cold water is supplied to emergency safety fixtures, the temperature shall be controlled by a temperature actuated mixing valve complying with ASSE 1071.
   02 Valves for individual showers are addressed in Section 22 40 00 - Plumbing Fixtures
   03 (Master) mixing valves serving multiple showers, each with a single tempered water supply pipe, shall conform to ASSE 1069 or CSA B125.3. Such valves shall be provided complete with unions, checks, and ball valves at all connections as well as a temperature gauge on the outgoing water line.
   04 Mixing valves serving (athletic area) whirlpool applications shall conform to ASSE 1070 / ASME A112.1070 / CSA B125.70 or CSA B125.3. Such valves shall also be configured with appurtenances as described above.
   05 Mixing valves supplying tempered water to lavatories and sinks shall conform to ASSE 1070 / ASME A112.1070 / CSA B125.70 or CSA B125.3.

C. ACCEPTABLE MANUFACTURERS:
   01 Bradley
   02 Powers
   03 Symmons
   04 Acorn
   05 Leonard

2.5 FLOOR DRAINS AND FLOOR SINKS

A. Provide floor drains and floor sinks in accordance with manufacturer's recommendations, as appropriate for floor construction per ASME A112.6.3, and as indicated and scheduled on Drawings.

B. Provide clamping devices for all drains in membrane floor areas.

C. ACCEPTABLE MANUFACTURERS:
   01 J.R. Smith
   02 Zurn
   03 Mifab
   04 Watts
   05 Wade

D. Provide drains of suitable and compatible material for specialized piping systems conveying acid waste.

2.6 CLEANOUTS

A. General: Provide cleanouts as indicated and scheduled on Drawings and also as required by the prevailing code, whether shown on the Drawings or not.

B. Construction: All cleanouts shall have tapered PVC, ABS, or polypropylene plugs.

C. Provide clamping devices for all cleanouts in membrane floor areas.

D. Provide cleanouts of suitable and compatible material for specialized piping systems conveying acid waste.

E. Types:
   01 Finished floor cleanouts: Provide cast iron body, with adjustable floor level assembly, and round nickel bronze scoriated top.
   02 Resilient or tile finished floor cleanouts: Provide cast iron body, with adjustable floor level assembly, and round nickel-bronze top with gasketed water tight cover and depressed top to receive flooring finish material.
   03 Interior finished wall cleanouts: Provide cast iron tee body or cleanout ferrule as required for wall construction and provide counter-sunk plug with stainless steel access cover and securing screw(s).
   04 Interior unfinished accessible cleanouts: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

F. ACCEPTABLE MANUFACTURERS:
   01 J.R. Smith
   02 Zurn
   03 Mifab
   04 Watts
   05 Wade

2.7 TRAP PRIMERS

A. General: Provide trap primers as indicated and scheduled on Drawings and in accordance with manufacturer’s recommendations.

B. ACCEPTABLE MANUFACTURERS:
   01 J.R. Smith
   02 Zurn
   03 Mifab
   04 Watts
   05 Wade
   06 P.P.P.

2.8 INTERCEPTORS

A. General requirements:
   01 Provide in type, materials of construction, and with appurtenances as indicated on the Drawings and as required for a complete, functioning, and compliant installation. This shall include, but not necessarily be limited to, the following: venting, flow control, inlet and outlet piping adapters/transitions, and cleanouts.
   02 Unless specifically noted otherwise, each interceptor shall be provided with an approved sampling well/sampling port in accordance with local AHJ requirements.
   03 All interceptors shall be a of flow rate/capacity, size, and design as suited to the waste stream being served and in accordance with local AHJ requirements.
   04 Buried interceptors shall be provided with suitable extensions up to finished grade/paving.
   05 Buried interceptors shall be provided with approved and suitable access lids/manhole covers.
      a. In vehicular traffic areas these shall be provided in material and load rating accordingly, suited for the weight of the traffic to be encountered.
      b. In no case shall lids be rated for anything less than pedestrian traffic.
      c. All lids shall be lined/gasketed for odor control.
   06 Interceptors shall not be provided of a material or at an installed depth they are not suited for. Maximum installation depths and bedding-backfill-bury requirements shall be adhered to in strict accordance with the manufacturer's recommendations.
   07 Buried interceptors in high water table locations shall be provided complete with the manufacturer's approved anchoring kit. The same shall apply to unburied interceptors in flood prone locations.
   08 Interceptor placement and installation shall be coordinated accordingly with adjacent items and equipment, floor/slab construction, site paving/grading, etc. to ensure a compliant installation and all required service and maintenance access.
   09 IAPMO (UPC), ICC (IPC), and local AHJ approval.

B. Acceptable manufacturers (where such units are detailed/specified on the Drawings):
   01 Precast concrete constructed: Park-USA, Old Castle Precast

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to provide intended performance.

B. Install equipment specific drains appropriately located to serve the equipment. Drain placement shall not conflict with housekeeping pads, casework, equipment access, clear space for foot travel, etc. In kitchens and similar settings final drain locations must be carefully coordinated to ensure that equipment casters, table legs, etc. do not bear upon drain grates.

C. Water hammer arresters:
   01 The contractor shall provide water hammer arresters as shown on Drawings and also in accordance with PDI-WH 201, whether shown on Drawings or not.
   02 Water hammer arresters shall be PDI certified and sized and placed as recommended by manufacturer.
   03 Provide above lay-in ceiling, within chase or wall or above solid ceiling complete with access panel, or otherwise accessible location complete with isolation valve to facilitate replacement.
   04 Provide for both domestic hot and cold water services.

05 The provision of air chambers for the control of water hammer shall not be acceptable, but for within dwelling units only, in residential occupancies only.

D. Backflow preventers:
01 Provide strainers at all backflow preventers.
02 Contractor shall certify all newly installed backflow preventers and provide proof of certification to the Owner.
03 Pipe relief line from backflow preventer via manufacturer’s air gap assembly, full size to nearest suitable drain. Such routing shall not pose a trip hazard. Where a suitable drain of appropriate size is not provided, route line to the outdoors.
04 All backflow preventers shall be securely supported with wall supports and/or pipe stands as appropriate for the size and weight of the unit and shall be installed with sufficient access and clearance for testing and maintenance. Unless specifically noted otherwise on Drawings, all backflow preventers shall be installed at 48”-60” above finished floor.
05 Unless specifically noted otherwise on the Drawings, outdoor installations shall be housed within an appropriately sized, ASSE 1060 Class I freeze and vandal protective insulated, marine grade aluminum constructed enclosure complete with drain panel and removable/movable panel(s) for device maintenance and testing. Provide complete with manufacturer's recommended electric heater. Safe-T-Cover by Hydrocowl.

E. Cleanouts:
01 Provide two-way cleanouts at all waste outfalls from the building.
02 Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at all cleanouts for access and for rodding of drainage system.
03 Wall cleanouts provided at the end of horizontal piping runs shall be installed vertically above the flow line of the pipe served.
04 All cleanouts outside of building not in paved areas shall be set in an 18" x 18" x 4" thick concrete pad, flush with final grade.
05 All cleanouts shall be the same nominal size as the pipe they serve, up to 4 inches. For pipes larger than 4 inches, provide a 4 inch cleanout.

F. Interceptors:
01 Coordinate with casework to ensure that all interceptors are readily accessible and removable for servicing and cleaning.
02 Coordinate with casework to ensure that all point of use interceptors do not interfere with required accessibility requirements. Provide offset(s) as required and in accordance with code.
03 Provide approved sampling well downstream of centralized interceptors and separators and in all such locations where required by the local Authority Having Jurisdiction.
04 Installation shall be in accordance with the manufacturer's recommendations.
05 The following general installation requirements shall apply to concrete constructed interceptors, however these requirements are not intended to supercede the manufacturer's recommendations, which shall govern.
a. The bottom of the excavation shall be covered with clean sand or pea gravel to a depth of no less than one foot, suitably graded and leveled. Limestone shall not be acceptable.
b. If the installation location has significant variation in ground water levels, the bedding material shall be fine gravel or pea gravel rather than sand.
c. The backfill shall be free from any material which may cause damage to the tank coating (if any) and placed accordingly.

G. Trap primers:

01 In unfinished areas such as mechanical rooms, such devices may be installed exposed.

02 In finished areas, all devices must be installed concealed from public view. If not readily accessible (such as above a lay-in ceiling) ensure to provide an access door.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the equipment covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:
01 Domestic Water Heaters
02 In-line Circulator Pumps

1.3 RELATED SECTIONS

A. Section 11 40 00 - Foodservice Equipment

B. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

C. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping

D. Section 22 10 00 - Plumbing Piping

E. Section 22 11 19 - Plumbing Specialties

F. Section 26 05 19 - Wire, Cable and Related Materials

1.4 REFERENCES

A. 10 CFR 430, Appendix E to Subpart B - Uniform Test Method for Measuring the Energy Consumption of Water Heaters; Current Edition.

B. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2019 (Reaffirmed 2024).

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023, with Errata (2024).

E. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2018, with Editorial Revision (2019).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

G. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 54 - National Fuel Gas Code; 2024.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

K. UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Perform Work in accordance with Authorities Having Jurisdiction.

C. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

D. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
   01 American Gas Association (AGA).
   02 National Sanitation Foundation (NSF).
   03 American Society of Mechanical Engineers (ASME).
   04 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
   05 National Electrical Manufacturers' Association (NEMA).
   06 Underwriters Laboratories (UL).
   07 American Society of Plumbing Engineers (ASPE)

E. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Shop Drawings:
   01 Include water heater and packaged heating system dimensions, sizes and locations of all connections, and performance data.
   02 Include dimensions of tanks, tank lining and insulation methods, anchors, attachments, lifting points, sizes and locations of all connections and drains.
   03 Include water softening equipment dimensions, sizes and locations of all connections, performance data and capacities, backwash requirements.

04 Include booster system skid dimensions, sizes and locations of all connections, and performance data. Include such information for any field connected items, including, but not necessarily limited to, hydro-pneumatic tanks.

05 Include manufacturer’s recommended space requirements, clearances, and maintenance access.

C. Product Data:

01 Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

02 Indicate pump type, materials of construction, capacity, power requirements, and any affected adjacent construction.

03 Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

04 Provide electrical characteristics and power and controls connection requirements/capabilities.

D. Manufacturer's Installation Instructions.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of equipment.

C. Provide written start-up reports.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 22.

B. Operation Data: Include manufacturer’s operating instructions, common trouble conditions and remedies, and trouble-shooting protocols.

C. Maintenance Data: Include routine maintenance items and corresponding intervals, identify typical replacement parts including part numbers and availability. Provide location and full contact information including after-hours maintenance/support telephone numbers for manufacturer authorized maintenance and repair companies.

1.9 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled equipment to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of equipment to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept equipment on site in original factory packaging. Inspect for damage. Damaged equipment shall not be acceptable.

D. STORAGE: Store equipment in a clean, dry location, protected from weather and damage.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two sets of electric water heater elements.

1.11 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two weeks prior to the proposed training session for review and approval.

B. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes, and corrections.
   06 On site demonstration.

1.12 REGULATORY REQUIREMENTS

A. Conform to AGA, NSF, NFPA 54, NFPA 70 and UL 1453 requirements for water heaters.

B. Conform to ASME BPVC-VIII-1 for manufacture of pressure vessels for heat exchangers.

C. Conform to water heater minimum efficiency requirements prescribed by ICC (IECC) and ASHRAE Std 90.1 I-P

D. Water heaters shall be tested and rated in compliance with 10 CFR 430, Appendix E to Subpart B or ANSI Z21.10.3 as applicable.

1.13 WARRANTY

A. Provide one year warranty under provisions of Division One, unless specifically noted otherwise.

B. Warranty: Include coverage of domestic water heaters and packaged systems, water storage tanks, water softeners, and domestic pressure booster systems.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS (STORAGE TYPE)

A. Acceptable Manufacturers:
   01 A.O. Smith
   02 State
   03 Rheem
   04 Lochinvar
   05 Bradford White
   06 Bock

B. Type: Factory-assembled and wired, electric, vertical storage.

C. Tank: Glass lined welded steel; 4 inch diameter inspection port (when applicable), thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.

D. Controls: Automatic water thermostat with externally adjustable temperature range from 110 to 170 degrees F (approximate, based on element configuration), replaceable elements of zinc plated copper or nickel chromium alloy, high temperature limit cutoff, enclosed controls and electrical junction box.

E. Accessories: Brass water connections and dip tube, drain valve, high-density magnesium anode, and ASME rated temperature and pressure relief valve.

F. Provide training per 1.11.

2.2 THERMAL EXPANSION TANKS

A. Acceptable Manufacturers:
   01 Watts
   02 Amtrol
   03 Elbi
   04 Bell and Gossett

B. Rating: Ensure suitable pressure rating of tank for expected system pressure.

C. Construction: Welded steel construction per ASME BPVC-VIII-1, corrosion-proof anti-microbial polypropylene liner, long-life heavy duty butyl compund diaphragm, stainless steel system connection, factory pre-charged, complete with welded air charge fitting with protective cap. Suitable for in-line installation or factory provided with stand/legs for floor-mounted installation.

2.3 IN-LINE CIRCULATOR PUMPS

A. Acceptable Manufacturers:
   01 Grundfos
   02 Bell & Gossett
   03 Armstrong

B. Variable speed capable circulator pump controlled by integral variable frequency drive with features and functions as described below:
   01 Type: Wet, canned-rotor, maintenance-free design.
   02 Housing: ASTM A351/A351M stainless steel with flanged connections.
   03 Maximum Operating Pressure: Suited for no less than 150 psig.
   04 Maximum Fluid Temperature: Suited for no less than 200 degrees F.
   05 Impeller: Composite.
   06 Motor: Electronically commutated (EC) permanent magnet motor suited for speed control via interated frequency converter.
   07 Control features: Integrated display on controller box, built-in differential-pressure and temperature sensor, multiple pump control modes - including the capabilty to be set to maintain constant return water temperature concurrent with a "not to exceed" maximum flow rate. Bluetooth ready and BMS capable.
   08 Basis of Design: Grundfos Magna 3 series, -GF-N with performance as scheduled on the Drawings.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, NFPA 54 and UL requirements.

B. Coordinate with plumbing piping and related work to achieve operating system.

C. Provide intake air/venting and associated piping in accordance with both code requirements and manufacturer's recommendations.
   01 The material and installation provided must not only be compatible with the equipment served but must also be suited to and acceptable per project conditions.
   02 Any material to be provided in a return air plenum must be compliant for such use. Any plastic piping must be UL 1738 certified and where located outdoors shall be painted with latex paint for UV protection.The flue vent shall be listed as an approved product for use with the heater manufacturer. Compatibility with the heater manufacturer shall be verified and documented.
   03 The flue vent shall be listed as an approved product for use with the heater manufacturer. Compatibility with the heater manufacturer shall be verified and documented.

D. Provide a properly sized thermal expansion tank downstream of the associated check valve in the cold water supply to the heater.

E. Provide a thermometer at the hot water outlet piping from each water heater.

F. Provide a line sized shut-off valve in the cold water supply to and in the hot water outlet from each heater, close to each heater.

G. Provide approved heat traps at all storage type water heaters not furnished from the manufacturer with integral heat traps or heat trap nipples.

H. Provide a line size plug cock in the gas supply close to each gas-fired water heater.

I. Provide approved dielectric couplings at all hot and cold water connections to each heater/tank, and at the T&P relief valve connection.

J. All tank type water heaters with more than 20 gallons of storage capacity shall be floor mounted on a concrete housekeeping pad, unless specifically indicated otherwise on the Drawings.

K. Each tank type water heater shall be installed within a suitably sized galvanized drain pan. Securely elevate the base of each heater above the floor of the drain pan with structurally sound, non-ferrous, non-absorbent supports. Drain pan shall have no less than a 3/4" piped drain outlet.

L. All water heater drain lines shall be full size, copper, and routed to indirect waste receptors.

M. Startup:
   01 Startup of all water heaters shall be in strict accordance with manufacturer's recommendations.
   02 Ensure that storage type water heaters are full of water and downstream fixtures have been run for no less than 3 minutes in order to purge any trapped air from the water heater tank prior to heater startup.

3.2 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide air cock and drain connection on horizontal pump casings.

C. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

D. Provide line sized isolating valve and line sized soft seated check valve on each submersible or sump pump discharge. Ensure to drill a 3/16" diameter horizontal weep hole near the base of the discharge piping to allow for venting and prevent air lock of the pump.

E. Provide line sized isolating valve and strainer at inlet and line sized soft seated check valve and line sized isolating valve at outlet of each in line circulator pump. Provide unions on both sides of pump.

F. 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. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

G. Ensure pumps operate at specified system fluid temperatures 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.

H. Align and verify alignment of base mounted pumps prior to start-up. Provide alignment certificate to engineer prior to start-up.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 22 02 00 - Basic Materials and Methods for Plumbing shall be included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fixtures covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:
01 Plumbing Fixtures
02 Fixture Carriers
03 Faucets, Supplies, and Trim
04 Flushometers

1.3 RELATED WORK

A. Section 22 05 29 - Hangers and Support for Plumbing Piping and Equipment

B. Section 22 10 00 - Plumbing Piping

C. Section 22 11 19 - Plumbing Specialties

D. Section 22 30 00 - Plumbing Equipment

1.4 REFERENCES

A. ASME A112.4.3 - Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System

B. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

C. ASME A112.18.1 - Plumbing Supply Fittings

D. ASME A112.18.2 - Plumbing Waste Fittings

E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures

F. ASME A112.19.1 - Enameled Cast Iron and Enameled Steel Plumbing Fixtures

G. ASME A112.19.2 - Ceramic Plumbing Fixtures

H. ASME A112.19.3 - Stainless Steel Plumbing Fixtures

I. ASME A112.19.7 - Hydromassage Bathtub Systems

J. NSF/ANSI 61 - Drinking Water System Components - Health Effects

K. ANSI Z358.1 - Emergency Eyewash and Shower Equipment

L. ASSE 1016 - Performance Requirements for Individual Thermostatic, Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings.

M. ASSE 1037 - Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures

N. ADA (Americans with Disabilities Act)

O. TAS (Texas Accessibility Standards)

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Warranty: Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or non-conforming materials and workmanship.

C. Defects shall include, but not necessarily be limited to, the following:
   01 Noisy operation.
   02 Noticeable deterioration of finish.
   03 Leakage of water.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data under provisions of Division One.

C. Include component sizes, rough-in requirements, service sizes, finishes, materials, dimensions, performance information, and accessories.

D. Manufacturer’s Installation Instructions: Indicate assembly and support requirements.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Provide pre-printed operating and maintenance instructions for each item specified. Instruct and demonstrate the proper operation and maintenance to the Owner's designated representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the Contract Documents.

B. Confirm and field coordinate that millwork is constructed with adequate provisions for the installation of counter top lavatories and sinks.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. GENERAL: Provide plumbing fixtures in accordance with manufacturer's recommendations and as indicated and scheduled on Drawings. Acceptable manufacturers of each fixture type are as indicated below.
   01 Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise.
   02 Fixture drilling shall match faucet spread and match any related trim and accessories.

B. WATER CLOSETS, URINALS, LAVATORIES (Vitreous China)
   01 American Standard
   02 Kohler
   03 Zurn
   04 Sloan
   05 Toto

C. SINKS - FREESTANDING (Stainless Steel)
   01 Elkay
   02 Just
   03 Advance Tabco
   04 Amtekco Industries

D. MOP SINKS
   01 Stern-Williams
   02 Fiat
   03 E.L. Mustee & Sons

E. DRINKING FOUNTAINS AND WATER COOLERS
   01 Halsey Taylor
   02 Elkay
   03 Haws
   04 Oasis

2.2 FAUCETS, SUPPLIES, AND TRIM

A. GENERAL: Provide faucets, supplies, and trim in accordance with manufacturer's recommendations, as appropriate for fixtures to be served, and as indicated and scheduled on Drawings. Acceptable manufacturers for each type of appurtenance are as indicated below.

01 Flushometer flush rate shall match gallon-per-flush criteria of fixtures served.

02 Strainers shall be heavy cast brass chrome plated with matching grid type strainer, with or without overflow as required, 17 gauge seamless brass tailpiece of length determined by installation requirements. Provide complete with washers and brass locknut.

03 P-traps shall be 17 gauge seamless chrome plated brass, adjustable type. Provide complete with cleanout plug, chrome plated brass slip nuts, wall bend, and wrought brass escutcheon of depth determined by installation requirements.

04 Angle stops shall be lead-free commercial pattern chrome plated brass, quarter turn ball type with loose key handles. Provide complete with chrome plated copper supply risers and wrought brass escutcheon of depth determined by installation requirements.

05 Toilet seats shall be commercial grade and provided complete with stainless steel posts and self-sustaining check hinges.

06 Pipe trim insulation shall be compliant, white molded vinyl, fade/discoloration-resistant, bacteria/fungal-resistant insulation.

07 Where an exposed flush valve assembly will conflict with the installation height of a grab bar or where there will be insufficient clearance above the top cover of an exposed flush valve for maintenance access relative to the installation height of a grab bar, provide an offset type flush valve tube. Make water rough-in and other adjustments as necessary for a compliant and functioning installation.

B. FAUCETS

01 Chicago
02 T&S Brass
03 Zurn
04 Moen Commercial
05 Delta Commercial
06 American Standard
07 Kohler
08 Symmons Commercial
09 Speakman

C. FLUSHOMETERS

01 Sloan
02 Zurn
03 Moen Commercial
04 Delta Commercial
05 American Standard
06 Toto

D. SUPPLY STOPS

01 McGuire
02 Zurn
03 Chicago
04 Dearborn Brass
05 Brasscraft

E. CHROME PLATED TUBULAR BRASS

01 McGuire

02 Zurn
03 Kohler
04 Dearborn Brass
05 Brasscraft

F. TOILET SEATS
01 Church
02 Bemis
03 American Standard
04 Zurn
05 Toto
06 Centoco

G. PIPE TRIM INSULATION
01 Truebro
02 McGuire
03 Plumberex

2.3 FIXTURE CARRIERS

A. GENERAL: ASME A112.6.1M; Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise. Fixture carrier foot supports shall be securely anchored to the floor with 1/2” bolts and anchors at all locations.
01 Chair type carriers shall be adjustable, with coated cast iron body with integral no hub waste and vent connections, complete with gasketed adjustable faceplate assembly, adjustable nipple with test cap, neoprene bowl gasket, lugs for floor and wall attachment, threaded fixture studs, and hardware. Provide single or double type of vertical or horizontal configuration as required and with auxiliary inlet as required.
02 Lavatory carriers shall be adjustable, with steel uprights and welded base feet, coated cast iron support brackets, cast or ductile iron concealed support arms, alignment rod, complete with leveling and support hardware. Provide single or back to back configuration as required.
03 Drinking fountain and urinal carriers shall be adjustable, with steel uprights and welded base feet, upper and lower bearing plates, threaded rods, and mounting hardware. Provide single or side-by-side configuration as required

B. ACCEPTABLE MANUFACTURERS
01 J.R. Smith
02 Zurn
03 Mifab
04 Watts
05 Wade
06 Josam

PART 3 - EXECUTION

3.1 PREPARATION

A. EXAMINATION OF CONDITIONS: Examine conditions affecting this work. Report unsatisfactory conditions to the proper authority and do not proceed until those conditions have been corrected. Commencing work implies acceptance of existing conditions as satisfactory to the outcome of this work.

B. Coordinate cutting of floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Install fixtures in locations and heights as shown on Drawings and as directed by the Architect.

B. Install materials plumb, level, securely, and in accordance with manufacturer's recommendations.

C. All rough-in pipe openings for final connections with supply, waste, vent, and storm systems shall be closed with caps or plugs during early stages of construction and installation. Tape shall not be considered sufficient protection.

D. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

E. Provide ball valves in piping serving batteries of fixtures. Label stops "Hot" and "Cold." Valves shall be located above accessible ceilings. If ceilings are not accessible, provide access panels of adequate size to ensure valves are fully accessible and can be fully operated.

F. Provide lockable ball valves in piping serving emergency safety fixtures and clearly label such valves as to the fixtures served.

G. Plumbing fixtures shall be supported by a concealed carrier where required to properly support the fixture specified. All carriers to be securely mounted, bolted and checked prior to concealment.

H. Caulk around fixtures with best grade white silicone caulking. Do not use grout.

I. All handles on supply and drainage fittings or other brass items shall be properly lined up and adjusted. Fittings shall not be left in any haphazard manner.

J. Fixtures shall have individual chrome plated heavy pattern loose key quarter-turn cutoff stops on supply lines, complete with escutcheons. Where same are not specified as a part of the fixture trim, they shall be installed as close to fixtures as possible in the hot and cold water supply. A loose key for each stop shall be provided to the Owner.

K. Install each fixture with trap, easily removable for servicing and cleaning.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Review architectural drawings. Confirm configuration and orientation of shower controls and trim prior to rough-in and installation.

3.4 ADJUSTING

A. Adjust work under provisions of Division One.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

A. Clean work under provisions of Division One.

B. At completion clean plumbing fixtures and appurtenances.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Division One.

B. Do not permit use of fixtures.

3.7 ADA ACCESSIBLE FIXTURES

A. At all locations required to be accessible, such fixtures, controls, and final installations shall comply with the requirements of ADA and any applicable state accessibility standards. Install fixtures to heights, indicated on architectural drawings.

B. All exposed water supply and drain pipes under accessible lavatories and sinks shall be insulated with securely fastened pipe trim insulation kits of the proper model for the fixtures specified.

C. Wall mounted drinking fountains and coolers which protrude into passages or corridor space, whether single or paired with an adjacent accessible fixture, shall be supplied with a matching skirt or apron to lower the underside clearance of the non-accessible fixture equal to that required for accessible fixture.

END OF SECTION

SECTION 23 02 00

BASIC MATERIALS AND METHODS FOR HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect/Engineer for review as soon as practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is the equivalent of that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Mechanical (HVAC) items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the commissioning process as required; including, but not limited to, meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The Contract Documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the reviewed shop drawings.

B. All duct or pipe or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the Contractor at no additional cost to the Owner.

D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified. Prime and protective painting are included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to Mechanical (HVAC) systems.

C. Furnishing and installing all required Mechanical (HVAC) equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.7 DATE OF SUBSTANTIAL COMPLETION

A. The date of final acceptance shall be the date of substantial completion. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct - properly protected from incidental damage and weather damage.

C. Damaged equipment, duct or pipe shall be promptly removed from the site and new, undamaged equipment, pipe or duct shall be installed in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The heating, ventilating and air conditioning systems, and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping and other items.

C. Carefully fabricate ductwork and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 DELEGATED DESIGN FOR ANCHORAGE OF ROOF MOUNTED EQUIPMENT

A. The Contractor shall engage a qualified professional engineer to design all roof mounted equipment curbs, equipment supports, equipment tie downs, equipment connections, and methods of attachment for components that are to be anchored to the building structure. The design shall comply with wind load and uplift requirements utilizing design criteria per ICC (IBC) and ASCE 7 unless criteria is otherwise indicated in the Construction Documents.

B. Submittal: Signed and sealed engineering analysis data and accompanying details, drawings, and supplemental installation information shall be submitted to the engineer for review.

1.11 APPLICABLE CODES AND STANDARDS

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements which includes and is not limited to the following nationally accepted codes and standards:

01 Air Moving & Conditioning Association, AMCA.
02 American Standards Association, ASA.
03 American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
04 American Society of Mechanical Engineers, ASME.
05 American Society of Plumbing Engineers, ASPE.
06 American Society of Testing Materials, ASTM.
07 American Water Works Association, AWWA.
08 National Bureau of Standards, NBS.
09 National Fire Protection Association, NFPA.
10 Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
11 Underwriters' Laboratories, Inc., UL.
12 International Building Code, IBC.
13 International Energy Conservation Code, IECC.
14 International Fire Code, IFC.
15 International Fuel Gas Code, IFGC.
16 International Mechanical Code, IMC.

D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.

E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.12 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor, or its Subcontractor or Sub-subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor or, when so noted, by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by the latest ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.13 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the Work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is the equivalent of the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturer’s standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equivalent capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 calendar days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equivalent construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUIVALENT" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUIVALENT" product, material or method may be used if it complies with the Specifications and is submitted for review to the Engineer as outline herein.

I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected Subcontractors shall be the responsibility of this bidder and not the Owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with the requirements listed above; and if accepted, will issue a letter allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with their respective trade(s) and all other trades; and to pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

1.14 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

01 A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

02 An index page with a listing of all data included in the Submittal.

03 A list of variations page with a listing of all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

04 Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

05 Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

06 Identification of each item of material or equipment matching that indicated on the Drawings.

07 Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

08 Additional information as required in other Sections of this Division.

09 Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

01 REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

02 REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

03 NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

04 REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

05 CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating that the submittal meets all conditions of the Contract Documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

06 MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified. The Contractor will automatically be required to furnish the product, material or method named in the Specifications. Contractor shall not order equipment when submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without submittal review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Submittals are required for, but not limited to, the following items subject to project requirements:

01 Coordination Drawings
02 Common Motor Requirements for HVAC Equipment
03 Hangers and Support for Piping and Equipment HVAC
04 Vibration and Seismic Controls for HVAC Piping and Equipment
05 Testing, Adjusting, and Balancing

06 Duct Insulation
07 HVAC Piping Insulation
08 Energy Management and Control System
09 Above Ground Hydronic Piping
10 Refrigerant Piping
11 Metal Ductwork
12 Ductwork Accessories
13 HVAC Fans
14 High-Volume Low-Speed Propeller Fans
15 Air Distribution Devices
16 HVAC Gravity Ventilators
17 Air Cooled Condensing Units
18 Energy Recovery Ventilator
19 Split System Air-Conditioners - Wall-Mounted
20 Fan Coil Unit

I. Refer to other Division 23 sections for additional submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.15 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access, and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

01 Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm and sanitary sewer piping.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Valve stem movement.
   k. Structural floor, wall and roof opening sizes and details.

02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting coordination drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.16 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 23.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Record Drawings shall indicate, at a minimum, the following installed conditions:
   01 Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
   02 Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
   03 Equipment locations (exposed and concealed), dimensioned from prominent building lines.
   04 Approved substitutions, Contract Modifications, and actual equipment and materials installed.
   05 Contract Modifications, actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

F. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

G. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

   CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____

(SIGNATURE)

1.17 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with Division 00 and Division 01 and, in addition to the requirements specified in those Divisions, include the following information for equipment items:
   01 Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
      a. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
      b. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
      c. Servicing instructions and lubrication charts and schedules.

1.18 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled date for each test. This detailed completion and test schedule shall be submitted at least 90 days before the projected substantial completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of substantial completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to, those items outlined in Section 23 02 00.

1.19 OPERATING AND MAINTENANCE MANUALS

A. Prepare Operations and Maintenance manuals in accordance with the requirements of Division 01 and Division 23. In addition to the requirements of other Sections, this shall include the following information for equipment items:
   01 Identifying names, name tags designations and locations for all equipment.
   02 Valve tag lists with valve number, type, color coding, location and function.

03 Reviewed Shop Drawing submittals with exceptions noted compliance letter.
04 Fabrication drawings.
05 Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
06 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
07 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
08 Servicing instructions and lubrication charts and schedules.
09 Equipment and motor name plate data.
10 Wiring diagrams.
11 Exploded parts views and parts lists for all equipment and devices.
12 Color coding charts for all painted equipment and conduit.
13 Location and listing of all spare parts and special keys and tools furnished to the Owner.
14 Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

B. Coordinate with Division 01 for Operations and Maintenance manual requirements. Unless noted otherwise, bind together in “D ring” style three-ring binders (National model no. 79-883 or equivalent). Binders shall be large enough to allow ¼” of spare capacity. Include three (3) sets with all approved Shop Drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections with tabbed insertable dividers, labeled for easy reference. Utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 23 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

C. In addition to the bound “hard-copy” Operation and Maintenance manuals referenced above, provide an identical electronic copy in searchable PDF format, with all sections bookmarked within the file for easy reference. Provide a USB flash drive with the final manual to the Owner.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of fourteen (14) working days prior to the beginning of the operator training period.

E. Operating and Maintenance Manuals which the Engineer deems incomplete, poorly organized, or otherwise unacceptable will be rejected in writing. The Contractor will subsequently be required to again turn over Operating and Maintenance Manuals, with all deficiencies corrected, until deemed acceptable by the Engineer.

1.20 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include a minimum of 12 hours of onsite training in three (3) shifts of four (4) hours each.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period, obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 23 Sections for additional Operator Training requirements.

1.21 FINAL COMPLETION

A. At the completion of the Work, all equipment and systems shall be tested and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 23 for additional requirements.

B. Clean and adjust all air distribution devices and replace all air filters immediately prior to Substantial Completion.

C. Touch up and/or refinish all scratched equipment and devices immediately prior to Substantial Completion.

1.22 CONTRACTOR'S GUARANTEE

A. Use of the HVAC systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing; and, if granted, shall not cause the warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after the date of the Substantial Completion, and shall furnish (free of additional cost to the Owner) all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. All air conditioning compressors shall have parts and labor guarantees provided by the equipment manufacturer for a period of not less than 5 years beyond the date of Substantial Completion.

E. Refer to Sections in Division 23 for additional guarantee or warranty requirements.

1.23 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently, or otherwise, without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be at the Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

01 It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

02 If the client, Architect or Owner of the project requires electronic media for "record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

03 At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with "Buy American Act."

B. 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 screw driver cam locks.

C. 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.

D. Access Doors: shall be as follows:

01 Plaster Surfaces: Milcor Style K.

02 Ceramic Tile Surface: Milcor Style M.
03 Drywall Surfaces: Milcor Style DW.
04 Install doors only in locations approved by the Architect.

2.2 EQUIPMENT PADS

A. Provide 6-inch-high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of 6 inch beyond the equipment on all sides. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

B. Provide 6-inch-high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of 6 inch beyond the equipment on all sides. Provide a 4-foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in Divisions 2 through 48 for additional rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
01 Coordinate mechanical systems, equipment, and materials installation with other building components.
02 Verify all dimensions by field measurements.
03 Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
04 Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
05 Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
06 Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
07 Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
08 Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.

09 Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10 Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as possible, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.

11 Install access doors where units are concealed behind finished surfaces. Refer to paragraph 2.1 in this section and architect for access doors specifications and location.

12 Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13 Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curbs which match the roof slope and provides a level top for equipment installation. Refer to Architectural drawings and details.

14 The equipment to be furnished under these Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.

15 The Architectural and Structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.

16 Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.

17 Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.

18 Identification of Mechanical Equipment:

a. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.

b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

19 Provide construction filters for all air handling units, fan coil unit, VAV boxes, and all other air handling equipment during the entire construction period.

20 Provide temporary construction strains for all strainers in the hydronic systems during the initial flushing of the systems.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

01 Uncover Work to provide for installation of ill-timed Work.

02 Remove and replace defective Work.

03 Remove and replace Work not conforming to requirements of the Contract Documents.

04 Remove samples of installed Work as specified for testing.

05 Install equipment and materials in existing structures.

06 Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.

07 Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Paragraph 1.11 I for definition of "Installer."

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:

01 A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

02 During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.

03 Contractor shall not start-up any of the HVAC equipment unless the Owner, Architect and Engineer are signed off.

04 Start-up for major HVAC equipment such as chillers, cooling towers, variable frequency drives and hot water boilers shall be performed by a factory technician. The start-up shall include a written report signed off by Contractor, Engineer and Owner.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 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.

B. WORK SPECIFIED ELSEWHERE:
   01 Painting
   02 Automatic temperature controls
   03 Power control wiring to motors and equipment

1.3 WARRANTY

A. Warrant the Work specified herein for one year and motors for five years beginning on the date of substantial completion.

1.4 REFERENCE STANDARDS

A. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

B. NEMA MG 00001 - Motors and Generators; 2024.

1.5 SUBMITTALS

A. SHOP DRAWINGS: Indicate size material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures variations, and accessories.

C. MOTOR NAMEPLATE INFORMATION: Manufacturer's name, address, utility and operating data.

D. Refer to Division One for additional information.

1.6 DELIVERY AND STORAGE

A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.

B. TIME AND COORDINATION: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.

C. STORAGE: Store materials in a clean, dry location, protected from weather and abuse.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. APPROVED MANUFACTURERS: Provide motors by a single manufacturer as much as possible.
- 01 Baldor
- 02 Marathon
- 03 Siemens-Allis
- 04 General Electric
- 05 U.S. Motor

B. TEMPERATURE RATING: Provide insulation as follows:
- 01 CLASS B: 40 degrees C maximum.
- 02 CLASS F:
  - a. Between 40 degrees C and 65 degrees C maximum.
  - b. Totally enclosed motors.

C. STARTING CAPABILITY: As required for service indicated five starts minimum per hour.

D. PHASES AND CURRENT: Verify electrical service compatibility with motors to be used.
- 01 UP TO 3/4 HP: Provide electronically commutated brushless DC single phase motors with built-in inverter and microprocessor-based control.
- 02 1 HP AND LARGER: Provide squirrel-cage AC induction polyphase motors.
- 03 Name plate voltage shall be the same as the circuit's nominal voltage, serving the motor.

E. SERVICE FACTOR: 1.15 for polyphase; 1.35 for single phase.

F. FRAMES: U-frames 1.5 hp. and larger.

G. BEARINGS: Provide sealed re-greaseable ball bearings; with top mounted Zerk lubrication fittings and bottom side drains minimum average life 100,000 hours typically, and others as follows:
- 01 Design for thrust where applicable.
- 02 PERMANENTLY SEALED: Where not accessible for greasing.
- 03 SLEEVE-TYPE WITH OIL CUPS: Light duty fractional hp. motors or polyphase requiring minimum noise level.

H. ENCLOSURE TYPE: Provide enclosures as follows, except where otherwise indicated:
- 01 CONCEALED INDOOR: ODP (Open Drip Proof).
- 02 EXPOSED INDOOR: Guard Protected.
- 03 OUTDOOR TYPICAL: Type II. TEFC.
- 04 OUTDOOR WEATHER PROTECTED: Type I. WPI.
- 05 EXPLOSION PROOF, XP: For use in hazardous locations.

I. OVERLOAD PROTECTION: Built-in sensing device for stopping motor in all phase legs and signaling where indicated for fractional horse power motors.

J. NOISE RATING: "Quiet" except where otherwise indicated.

K. All motors that are to be operated by a variable frequency drive shall be inverter duty rated motors.

L. All motors operated by variable frequency drive shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential microfibers to discharge electrical shaft currents within the motor and/or its bearings.

M. EFFICIENCY: Minimum full load efficiency listed in the following table, when tested in accordance with IEEE 112, Method B, including stray load loss measure.

NEMA MG 00001 Efficiency - 1800 RPM Synchronous Speed		
Motor horsepower	Index Letter	Minimum Efficiency
3 - 5	G	89.5
7.5	G	91.0
10	F	91.7
15 - 20	E	93.0
25 - 30	E	93.6
40	D	94.1
50	C	95.0
60	C	95.0
75	C	95.0
100 - 125	B	95.4
150 - 200	B	95.8
NEMA MG 00001 Efficiency - 1200 RPM Synchronous Speed		
Motor horsepower	Index Letter	Minimum Efficiency
3 - 5	G	89.5
7.5	G	90.2
10	F	91.7
15	F	91.7
20	E	92.4
25 - 30	E	93.6
40 - 50	D	94.1
60	D	94.5
75	C	94.5
100 - 125	C	95.0
150 - 200	B	95.4

2.2 MOTOR CONTROLLERS (STARTERS)

A. All motor controllers (for equipment furnished under Division 23) shall be furnished under Division 23 and installed under Division 26 unless otherwise noted on the plans.
01 Starters shall be provided for 3 phase motors 1 horsepower and greater.

B. Motor starters shall be furnished as follows.
01 GENERAL: Motor starters shall be Square D Company Class 8536 across-the-line magnetic type, full-voltage, non-reversing (FAVOR) starter. All starters shall be constructed and tested in accordance with the latest NEMA standards, sizes and horsepower. ICE sizes are not acceptable. Starters shall be mounted in a general purpose dead front, painted steel enclosure and surface-mounted. Provide size and number of poles as shown and required by equipment served. Provide two speed, two winding or two speed, single winding motor starter as required for two speed motors.

02 CONTACTS: Magnetic starter contacts shall be double break solid silver alloy. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.

03 OPERATING COILS: Operating coils shall be 120 volts and shall be of molded construction. When the coil fails, the starter shall open and shall not lock in the closed position.

04 OVERLOAD RELAYS: Provide manual reset, trip-free Class 20 overload relays in each phase conductor in of all starters. Overload relays shall be melting alloy type with visual trip indication. All 3 phase and single phase starters shall have one overload relay in each underground conductor. Relay shall not be field adjustable from manual to automatic reset. Provide 6 overload relays for two speed motor starters.

05 PILOT LIGHTS: Provide a red running pilot light for all motor starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil.

06 CONTROLS: Provide starters with HAND-OFF-AUTOMATIC switches. Coordinate additional motor starter controls with the requirements of Division 23. Motor starter controls shall be mounted in the starter enclosure cover.

07 CONTROL POWER TRANSFORMER: Provide a single-phase 480 volt control power transformer with each starter for 120 volt control power. Connect the primary side to the line side of the motor starter. The primary side shall be protected by a fuse for each conductor. The secondary side shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.

08 AUXILIARY CONTACTS: Each starter shall have one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock", remote monitoring, and control wiring. In addition, it shall be possible to field-install three more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.

09 UNIT WIRING: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for line and load power wiring and HVAC control wiring.

10 ENCLOSURES: All motor starter enclosures shall be NEMA 1, general purpose enclosures or NEMA-3R if mounted exposed to high moisture conditions. Provide NEMA 4X when located by cooling towers.

11 POWER MONITOR: Provide a square "D" 8430 MPS phase failure and under-voltage relay, base and wiring required for starters serving all 3 phase motors. Set the under-voltage setting according to minimum voltage required for the motor to operate within its range.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturer's.

01 Siemens.
02 Square D.
03 General Electric.
04 Eaton.

2.3 COMBINATION MOTOR STARTERS

A. GENERAL: Combination motor starters shall consist of a magnetic starter and a fusible or non-fusible disconnect switch in a dead front, painted steel NEMA 1 enclosure unless otherwise noted and shall be surface-mounted. Size and number of poles shall as shown and required by equipment served. Combination motor starters shall be as specified for motor starters in Paragraph 2.02-B, except as modified herein.

B. DISCONNECT SWITCH: Disconnect switches shall be as specified in Section 26 28 16.

C. APPROVED MANUFACTURERS: Controller numbers are based on first named manufacturer. Provide one of the following manufacturer's.
   01 Siemens.
   02 Square D.
   03 General Electric.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturers' recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors' price shall include all items required as per manufacturers' requirements.

C. Install in a professional manner. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to Owner.

D. Install rotating equipment in static and dynamic balance.

E. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building.

F. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION

SECTION 23 05 16

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Flexible pipe connections.

B. Expansion joints and compensators

C. Pipe loops, offsets, and swing joints.

1.3 RELATED WORK

A. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 23 21 13 - Above Ground Hydronic Piping

C. Section 23 23 00 - Refrigerant Piping

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Expansion Calculations:
   01 Installation Temperature: 50 degrees F (10 degrees C)
   02 Hot Water Heating: 210 degrees F (99 degrees C)
   03 Domestic Hot Water: 140 degrees F (60 degrees C)
   04 Steam: 380 degrees F (193 degrees C)
   05 Steam Condensate: 212 degrees F (100 degrees C)
   06 Safety Factor: 30 percent.

C. Pipe sizes indicated are to establish a minimum quality of compensator. Refer to manufacturer’s literature for model series for different pipe sizes.

1.5 SUBMITTALS

A. Submit shop drawings under provisions of Division One.

B. Product Data:

01 Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

02 Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer`s Installation Instructions: Indicate special procedures, and external controls.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include adjustment instructions.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Design expansion compensation system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the project is located.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Division One.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY

A. Provide five year warranty under provisions of Division One.

B. Warranty: Include coverage for leak free performance of packed expansion joints.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Steel Piping (Based on 2" Pipe):
- 01 Manufacturers:
  - a. VMC Group, Model SS-PM or SS-FP
  - b. Mercer Rubber Company, Model BSS-EM (Mason Industries)
- 02 Inner Hose: Type 321, stainless steel, corrugated metal.
- 03 Exterior Sleeve: Type 304, single braided stainless steel.
- 04 Pressure Rating: 350 psig WOG and 70 degrees F. For 4 inch pipe - 200 psig WOG and 70 degrees F.
- 05 Joint: Schedule 40 steel, threaded with male nipple and hex boss each end and union. Flanged joints for pipe sizes 2½ inch and larger.
- 06 Size: Use pipe sized units.
- 07 Maximum offset: 1/2 inch on each side of installed center line.
- 08 Application: Air handling unit cooling and heating coils.

B. Copper Piping (Based on 2" Pipe):
- 01 Manufacturers:
  - a. VMC Group, Model BR-FS
  - b. Mercer Rubber Company, Model BFF (Mason Industries)
- 02 Inner Hose: Corrugated Bronze
- 03 Exterior Sleeve: Braided bronze.
- 04 Pressure Rating: 250 psig WOG and 70 degrees F.
- 05 Joint: Threaded with male nipple and hex boss each end with union. Flanged joints for pipe sizes 2½ inch and larger.
- 06 Size: Use pipe sized units.
- 07 Maximum offset: 1/2 inch on each side of installed center line.
- 08 Application: Air handling unit cooling and heating coils.

2.2 EXPANSION JOINTS

A. Bellows Type (Based on 4" Pipe):
- 01 Manufacturers:
  - a. VMC Group, Model EB
  - b. Mercer Rubber Company, Model 803 or 805 (Mason Industries)
- 02 Body: Monel wire reinforced molded TFE teflon bellows, multiple arch.
- 03 Pressure Rating: 70 psig WSP and 250 degrees F (66 degrees C).
- 04 Maximum Compression: 1 inch.
- 05 Maximum Extension: 1 inch.
- 06 Maximum Offset: 1/2 inch.
- 07 Joint: ASA standard ductile iron flanges, integral molded gasket.
- 08 Size: Use pipe sized units.
- 09 Accessories: Control rod limit bolts.
- 10 Application: Steel piping 8 inch and under.

2.3 ACCESSORIES

A. Pipe Alignment Guides to Direct Axial Movement:
- 01 Manufacturers:
  - a. Metraflex, Style IV
- 02 Two piece welded steel with shop paint, and bolted 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 in accordance with manufacturer`s instructions.

B. Construct spool pieces to exact size of flexible connection for future insertion.

C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provided line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Provide miscellaneous metals to rigidly anchor pipe to building structure. Provide pipe guides so that movement takes place along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

3.2 MANUFACTURER`S FIELD SERVICES

A. Prepare and start systems under provisions of Division One.

B. Provide inspection services by flexible pipe manufacturer`s representative for final installing and certify installation is in accordance with manufacturer`s recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT - HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe, and equipment hangers, supports and associated anchors.

B. Sleeves and seals.

C. Flashing and sealing equipment and pipe stacks.

1.3 RELATED WORK

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

B. Section 23 07 19 - HVAC Piping Insulation

C. Section 23 21 13 - Above Ground Hydronic Piping

1.4 REFERENCES

A. ASME B31.1 - Power Piping; 2024.

B. ASME B31.9 - Building Services Piping; 2020.

C. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.5 QUALITY ASSURANCE

A. Hangers and Supports for HVAC Piping: In conformance with ASME B31.1 and ASME B31.9.

B. Hangers and Supports for HVAC Piping: In conformance with MSS SP-58.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Indicate hanger and support framing and attachment methods.

C. Provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipes Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipes Sizes 2 to 4 Inch: Carbon steel, adjustable clevis.

C. Hangers for Pipes Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roller, double hanger.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers, pre-formed manufactured saddles and hanger rods; cast iron roller and stand for pipe sizes 6 inches and over.

E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

F. Wall Support for Pipe Sizes 4 Inches and over: adjustable steel yoke and cast iron roller.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roller and stand, steel screws, and concrete pier or steel support.

J. Roof Pipe Supports and Hangers: Galvanized Steel Channel System as manufactured by Portable Pipe Hangers, Inc. or approved equal.
   01 For pipes 2-1/2” and smaller - Type PP10 with roller
   02 For pipes 3” through 8” - Type PS
   03 For multiple pipes - Type PSE - Custom

K. Copper Pipe Support and Hangers: Electro-galvanized with thermoplastic elastomer cushions; Unistrut “Cush-A-Clamp” or equal. Hangers: Plastic coated; Unistrut or equal.

L. Shields for Vertical Copper Pipe Risers: Sheet lead.

M. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux Chief “Pipe Titan” or equal.

2.2 HANGER RODS

A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case with 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. Metal Flashing: 20 gage galvanized steel.

B. Lead Flashing: 4 lb. /sq. ft. sheet lead for waterproofing; 1 lb. /sq. ft. sheet lead for soundproofing.

C. Caps: Steel, 20 gage minimum; 16 gage at fire resistant elements.

D. Coordinate with roofing contractor/Architect for type of flashing on metal roofs.

2.5 EQUIPMENT CURBS

A. Fabricate curbs of hot dipped galvanized steel.

B. For metal roof construction, roof curbs shall be made of aluminum or stainless steel. Coordinate with Architectural Drawings and details.

2.6 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: Form with 18 gage galvanized steel, tack welded to form a uniform sleeve.

B. Sleeves for Pipes through Beams, Interior Walls, Exterior Walls, Footings, and Potentially Wet Floors: Form with steel pipe, Schedule 40, galvanized.

C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Fireproofing: Prefabricated fire rated steel sleeves including seals, UL listed, manufactured by Hilti.

D. Fire Stopping Insulation: Glass fiber type, non-combustible, UL listed.

E. Caulk: Paintable 25-year acrylic sealant.

F. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.7 MECHANICAL SLEEVE SEALS

A. Modular sealing element unit, designed for field assembly, to continuously fill annular space between pipe and sleeve and create watertight seal.
   - 01 Approved Manufacturers:
     - a. Link-Seal by Garlock Pipeline Technologies (GPT)
     - b. Innerlynx by Advance Products & Systems, Inc.
     - c. MetraSeal by Metraflex Co.
   - 02 Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material, size of pipe, and service requirements.
   - 03 Pressure Plates: Carbon steel. Include two for each sealing element.
   - 04 Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.9 FINISH

A. Exposed steel hangers, supports, and appurtenances shall be hot-dipped galvanized. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 INSERTS

A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with Structural Engineer for placement of inserts.

B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with Structural Engineer prior to start of work.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
(Steel Pipe)		
1/2 to 1-1/4 inch	7'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(Copper Pipe)		
1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
6 to 8 inch	10'-0"	1/2"
(Cast Iron Pipe)		
2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"

15 inch and over	10'-0"	7/8"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"
10 inch and over	4'-0"	5/8"

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow, and at the vertical to horizontal transition.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.

I. Portable pipe hanger systems shall be installed per manufacturer’s instructions.

J. Distances between supports are maximum distance. Supports shall be provided to carry the pipe/equipment load.

3.3 INSULATED PIPING

A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation. Secure the full contact area of the saddle to the pipe insulation with 1/8” thick coat of mastic.

C. Shields: Install protective shields MSS SP-58 Type 40 on cold and chilled water piping that has vapor barrier. Secure the full contact area of the shield to the pipe insulation with 1/8” thick coat of mastic.

D. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

Nominal Pipe Size	Shield Length	GaugeThickness
1/4 through 3-1/2 inch	12	18
4 inch	12	16
5 through 6 inch	18	16
8 through 14 inch	24	14
16 through 24 inch	24	12

E. Piping 2” and larger: provide galvanized sheet metal shields with calcium silicate insulation at hangers/supports.

F. Insert material shall be at least as long as the protective shield.

G. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment bases of concrete.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

D. Construct support of steel members. Brace and fasten with flanges bolted to structure.

E. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide curbs for mechanical roof installations that extend minimum 8 inches above adjacent roofing surface. Contact Architect for all flashing details and roof construction. Seal penetrations watertight.

3.6 SLEEVES

A. Sleeves shall be provided at the following locations:
   01 Piping passing through rated and non-rated floor assemblies, rated ceiling assemblies, and roof assemblies.
   02 Piping passing through concrete, masonry, and rated gypsum board walls and partitions.
   03 Piping passing through exterior wall assemblies above and below grade.
   04 Piping passing through non-rated gypsum board walls and partitions where indicated on the drawings or where exposed to view.
   05 Piping passing through structural members where indicated on the drawings or where exposed to view.
   06 Any other locations indicated on the drawings.

B. Set sleeves in position in formwork. Provide reinforcing around sleeves.

C. Extend sleeves through floors minimum one inch above finished floor level. Sleeves located in walls, ceilings, and structural members shall be flush with the outer surfaces of the assembly being penetrated.

D. Where sleeved piping penetrates a floor, ceiling, or interior wall assembly, pack annular space between pipe and sleeve with UL listed fire stopping insulation and caulk seal airtight with fire barrier sealant. Provide close fitting metal collar or escutcheon covers at both sides of wall penetrations and exposed side of ceiling penetrations.

E. Install all UL listed, prefabricated fire rated steel sleeves per the manufacturer's installation instructions to ensure fire rating is maintained.

F. Sleeves at exterior walls below grade shall be sealed with mechanical sleeve seal. Install seal per manufacturer's installation instructions. Select type and number of sealing elements required for pipe material, pipe size, and service requirements. Position pipe in center of sleeve. Assemble mechanical sleeve seal and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal. Locations above grade shall be provided with close fitting metal collar or escutcheon covers at both sides of penetration.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Vibration and sound control products.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

C. Unless otherwise indicated, sound and vibration control products shall be provided by a single manufacturer.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. VMC Group

B. Mason Industries, Inc.

C. Kinetics Noise Control, Inc.

D. Vibration Eliminator Co., Inc.

E. Vibro-Acoustics

2.2 GENERAL

A. Provide vibration isolation supports for equipment, piping and ductwork, to prevent transmission of vibration and noise to the building structure that may cause discomfort to the occupants.

B. Model numbers of VMC Group products are included for identification. Products of the listed manufacturers will be acceptable provided they comply with all the requirements of this specification.

2.3 SUSPENDED AIR HANDLING UNITS AND ENERGY RECOVERY UNITS

A. Provide VMC Group model HRS-2 combination spring and elastomeric isolation hanger sized for 2'' static deflection.

B. If suspended air handling units are furnished with internal vibration isolation option, provide VMC Group model HR elastomeric isolation hangers sized for approximately ½'' deflection to address high frequency break-out.

2.4 SUSPENDED FANS AND FAN COIL UNITS

A. Provide VMC Group model HS spring hangers sized for 1'' static deflection.

2.5 CONDENSING UNITS

A. Provide VMC Group model NRC, 1" thick ribbed elastomeric isolation pads sized for approximately 40 psi loading and 1/8'' deflection.

B. Pads shall be located in accordance with the condensing unit manufacturer's recommendations.

2.6 CORROSION PROTECTION

A. All vibration isolators shall be designed and treated for resistance to corrosion.

B. Steel components: PVC coated or phosphate coated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

3.1 INSTALLATION

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 on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

C. If internal isolation option is used on air handling units, the mechanical contractor shall verify proper adjustment and operation of isolators prior to start-up. All shipping brackets and temporary restraint devices shall be removed.

D. The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 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.

B. Refer to Architectural Sections for additional requirements.

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

PART 2 - PRODUCTS

2.1 VALVE AND PIPE IDENTIFICATION

A. Valves:

01 All valves shall be identified with a 1-1/2" diameter brass disc wired onto the handle. The disc shall be stamped with 1/2" high depressed black filled identifying numbers. These numbers shall be numerically sequenced for all valves on the job.

02 The number and description indicating make, size, model number and service of each valve shall be listed in proper operational sequence, properly typewritten. Three copies to be turned over to Owner at completion.

03 Tags shall be fastened with approved meter seal and 4 ply 0.018 smooth copper wire. Tags and fastenings shall be manufactured by the Seton Name Plate Company or approved equal.

04 All valves shall be numbered serially with all valves of any one system and/or trade grouped together.

B. Pipe Marking:

01 All interior visible piping located in accessible spaces such as above accessible ceilings, equipment rooms, attic space, under floor spaces, etc., shall be identified with all temperature pipe markers as manufactured by W.H. Brady Company, 431 West Rock Ave., New Haven, Connecticut, or approved equal.

02 All exterior visible piping shall be identified with UV and acid resistant outdoor grade acrylic plastic markers as manufactured by Set Mark distributed by Seton (Name plate Company Factory location 20 Thompson Road, Branford, Connecticut) or approved equal.

03 Generally, markers shall be located on each side of each and every partition, on each side of every tee, on each side of every valve and/or valve group, on each side of every piece of equipment, and, for straight runs, at equally spaced intervals not to exceed 75 feet. In congested area, marks shall be placed on each pipe at the points where it enters and leaves the area and at the point of connection of each piece of equipment and automatic control valve. All markers shall have directional arrows.

04 Provide pipe markers that meet labeling requirements of ASME A13.1 for all refrigerant piping located in areas other than the room or space where the associated equipment is located. Pipe markers shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation. The minimum height of the identification lettering shall be 1/2". The pipe identification shall indicate the refrigerant designation and safety group classification of the refrigerant used in the piping system. For Group A2, A3, B2, and B3 refrigerants, the identification shall also include the following statement: “DANGER – Risk of Fire or Explosion. Flammable Refrigerant.” For any Group B refrigerant, the identification shall also include the following statement: “DANGER – Toxic Refrigerant”.

05 Markers shall be installed after final painting of all piping and equipment and in such a manner that they are visible from the normal maintenance position. Manufacturer's installation instructions shall be closely followed.

06 Markers shall be colored as indicated below per ASME A13.1.

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply; Chilled Water Return
Hot Water	Reddish Orange	Hot Water Supply; Hot Water Return
Condenser Water	Green	Condenser Water Supply; Condenser Water Return
Compressed Air	Blue	Compressed Air
Pneumatic Control	Yellow	Pneumatic Controls
Oxygen	Yellow	Oxygen
Nitrogen	Green	Nitrogen
Deionized Water	Green	Deionized Water
Steam	Yellow	Steam Supply; Steam Return

C. Pipe Painting:

01 All piping exposed to view shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections with Architect prior to installation.

02 All piping located in mechanical rooms and exterior piping shall be painted as indicated below:

SYSTEM	COLOR
Condenser Water Supply and Return	Light Green
Chilled Water Supply and Return	Light Blue
Heating Hot Water Supply and Return	Reddish Orange

2.2 EQUIPMENT IDENTIFICATION

A. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal with minimum 1/2 inch high letters manufactured by Seton Company or approved equal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins, self-tapping screws, or machine screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All labeling equipment shall be installed as per manufacturer’s printed installation instructions.

B. Provide printable label on ceiling grids and access doors at all locations that provide access to mechanical equipment, valves, motorized dampers, and accessories located above ceiling. The label shall be white with black text with 1/4 inch high letters and shall identify the component that is accessible at that location.

C. Provide printable label on ceiling grids and access doors at all locations that provide access to fire dampers, smoke dampers, and combination fire/smoke dampers located above ceiling. The label shall be white with red text with 1/2 inch high letters reading: FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER to identify the damper type that is accessible at that location.

D. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor's price shall include all items required as per manufacturer’s requirements.

E. All piping shall be cleaned of rust, dirt, oil and all other contaminants prior to painting. Refer to Division 9 for Architect’s required paint system(s).

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 RELATED DOCUMENTS

A. Approved submittal date on equipment installed, to accomplish the test procedures, outlined under paragraph 3.01 of this Section, will be provided by the Contractor.

1.3 DESCRIPTION

A. The TAB of the air conditioning systems shall be performed by an impartial technical firm hired by the Owner whose operations are limited only to the field of professional TAB. The TAB work will be done under the direct supervision of a qualified engineer employed by the TAB firm.

B. The TAB firm will be responsible for inspecting, adjusting, balancing, and logging the date on the performance of fans, dampers in the duct system, and air distribution devices. The Contractor and the various Subcontractors of the equipment installed shall cooperate with the TAB firm to furnish necessary data on the design and proper applications of the system components and provide labor and material required to eliminate deficiencies or malperformance.

1.4 QUALITY ASSURANCE

A. QUALIFICATIONS OF CONTRACTOR PERSONNEL: Submit evidence to show that the personnel who shall be in charge of correcting deficiencies for balancing the systems are qualified. The Owner and Engineer reserve the right to require that the originally approved personnel be replaced with other qualified personnel if, in the Owner and Engineer's opinion, the original personnel are not qualified to properly place the system in condition for balancing.

B. QUALIFICATIONS OF TAB FIRM PERSONNEL:
   01 A minimum of one registered Professional Engineer licensed in the State, is required to be in permanent employment of the firm.
   02 Personnel used on the jobsite shall be either Professional Engineers or technicians, who shall have been permanent, full time employees of the firm for a minimum of six months prior to the start of Work for that specified project.
   03 Evidence shall be submitted to show that the personnel who actually balance the systems are qualified. Evidence showing that the personnel have passed the tests required by the Associated Air Balance Council (AABC) shall be required.

C. CALIBRATION LIST: Submit to the Engineer for approval, a list of the gauges, thermometers, velometer, and other balancing devices to be used in balancing the system. Submit evidence to show that the balancing devices are properly calibrated before proceeding with system balancing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SERVICES OF THE CONTRACTOR

A. The Drawings and Specifications have indicated valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions. Install these devices in a manner that leaves them accessible, and provide access as requested by the TAB firm.

B. Have systems complete and in operational readiness prior to notifying the TAB firm that the project is ready for their services, and certify in writing to the Architect and Owner that such a condition exists.

C. As a part of the Work of this Section, make changes in the sheaves, belts, and dampers or the addition of dampers required for correct balance of the new work as required by the TAB firm, at no additional cost to the Owner.

D. Fully examine the existing system to be balanced, to determine whether or not sufficient volume dampers, balancing valves, thermometers, gauges, pressure and temperature taps, means of reading static pressure and total pressure in duct systems, means of determining water flow, and other means of taking data needed for proper water and air balancing are existing. Submit to the Engineer in writing a listing of omitted items considered necessary to balance existing systems. Submit the list and proposal as a cost add item.

E. Verify that fresh air louvers are free of blockage, coils are clean and fresh air ducts to each air handling unit have individually adjustable volume regulating dampers.

F. Provide, correct, repair, or replace deficient items or conditions found during the testing, adjusting, and balancing period.

G. In order that systems may be properly tested, balanced, and adjusted as specified, operate the systems at no expense to the Owner for the length of time necessary to properly verify their completion and readiness for TAB period.

H. Project construction schedules shall provide time to permit the successful completion of TAB services prior to Substantial Completion. Complete, operational readiness, prior to commencement of TAB services, shall include the following services of the Contractor:
   01 Construction status of building shall permit the closing of doors, windows, ceilings installed and penetrations complete, to obtain project operating conditions.
   02 AIR DISTRIBUTION SYSTEMS:
      a. Verify installation for conformity to design. Supply, return, and exhaust ducts terminated and pressure tested for leakage as specified.
      b. Volume and fire dampers properly located and functional. Dampers serving requirements of minimum and maximum outside air, return and relief shall provide tight closure and full opening, smooth and free operation.
      c. Supply, return, exhaust and transfer grilles, registers and diffusers shall be installed.

d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and sealed to eliminate excessive bypass or leakage of air.

e. Fans (supply and exhaust) operating and verified for freedom from vibrations, proper fan rotation and belt tension; overload heater elements shall be of proper size and rating; record motor amperage and voltage and verify that these functions do not exceed nameplate ratings.

f. Furnish or revise fan drives or motors as necessary to attain the specified air volumes.

03 AUTOMATIC CONTROLS:

a. Verify that control components are installed in accordance with project documents and functional, electrical interlocks, damper sequences, air and water resets, fire and freeze stats.

b. Controlling instruments shall be functional and set for design operating conditions. Factory precalibration of room thermostats and pneumatic equipment will not be acceptable.

c. The temperature regulation shall be adjusted for proper relationship between the controlling instruments and calibrated by the TAB Contractor. Advise Engineer of deficiencies or malfunctions.

I. Contractor shall repair any insulation removed from piping system by TAB Contractor during water balancing.

3.2 SERVICES OF THE TAB FIRM

A. The TAB firm will act as liaison between the Owner, Engineer, and the Contractor and inspect the installation of mechanical piping system, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems being retrofitted, repaired, or added under this Contract. The reinspection of the Work will cover that part related to proper arrangement and adequate provision for the testing and balancing and will be done when the Work is 80 percent complete.

B. Upon completion of the installation and start-up of the mechanical equipment, to check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building. Prepare and submit to the Engineer complete reports on the balance and operations of the systems.

C. Measurements and recorded readings of air, water, and electricity that appear in the reports will be done by the permanently employed technicians or engineers of the TAB firm.

D. Make an inspection in the building during the opposite season from that in which the initial adjustments were made. At the time, make necessary modifications to the initial adjustments required to produce optimum operation of system components to affect the proper conditions as indicated on the Drawings. At time of opposite season check-out, the Owner's representative will be notified before readings or adjustments are made.

E. In fan systems, the air quantities indicated on the Drawings may be varied as required to secure a maximum temperature variation of two degrees within each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the Contractor to furnish or revise fan drive and motors if necessary, without cost to the Owner, to attain the specified air volumes.

F. Contractor shall utilize ultrasonic flow meter to balance water flow of existing water system if the original pressure drop data is not available. Contractor shall remove insulation as necessary to use flow meter.

G. Participate in the commissioning process, which shall include but not be limited to attending commissioning meetings, coordinating work with and completing checklists as required by the commissioning team.

3.3 PROFESSIONAL REPORT

A. Before the final acceptance of the report is made, the TAB firm will furnish the Engineer the following data to be approved by the Owner and Engineer:
   01 Summary of main supply, return and exhaust duct pitot tube traverses and fan settings indicating minimum value required to achieve specified air volumes.
   02 A listing of the measured air quantities at each outlet corresponding to the temperature tabulation as developed by the Engineer and TAB firm.
   03 Air quantities at each return and exhaust air handling device.
   04 Static pressure readings entering and leaving each supply fan, exhaust fan, filter, coil, balancing dampers and other components of the systems. Including the retrofit Work. These readings will be related to performance curves in terms of the CFM handled if available.
   05 Motor current readings at each equipment motor on load side of capacitors. The voltages at the time of the reading shall be listed.
   06 The final report shall certify test methods and instrumentation used, final velocity reading obtained, temperatures, pressure drops, RPM of equipment, amperage of motors, air balancing problems encountered, recommendations and uncompleted punch list items. The test results will be recorded on standard forms.
   07 A summary of actual operating conditions shall be included with each system outlining normal and ventilation cycles of operation. the final report will act as a reference of actual operating conditions for the Owner's operating personnel.

3.4 BALANCING AIR CONDITIONING SYSTEM

A. GENERAL:
   01 Place all equipment into full operation, and continue operating during each working day of balancing and testing. If the air conditioning system is balanced during Off-Peak cooling season Contractor shall return to rebalance air side system as required to put system in proper balance at that season.
   02 The Contractor shall submit detailed balancing and recording forms for approval. After approval by the Engineer, prepare complete set of forms for recording test data on each system. All Work shall be done under the supervision of a Registered Professional Engineer. All instruments used shall be accurately calibrated to within 1% of scale and maintained in good working order.
   03 Upon completion of the balancing and testing, the TAB Contractor shall compile the test data in report forms, and forward five copies to the Engineer for evaluation.
   04 The final report shall contain logged results of all tests, including such data as:
      a. Tabulation of air volume at each outlet.
      b. Outside dry bulb and wet bulb temperature.
      c. Inside dry bulb and wet bulb temperatures in each conditioned space room or area.
      d. Actual fan capacities and static pressures. Motor current and voltage readings at each fan.

B. AIR SYSTEMS: Perform the following operations as applicable to balance and test systems:
   01 Check fan rotation.
   02 Check filters (balancing shall be done with clean filters).
   03 Test and adjust blower rpm to design requirements.
   04 Test and record motor full load amperes.
   05 Test and record system static pressures, suction and discharge.

06 Test and adjust system for design cfm, return air and outside air (±2%). Change-out fan sheaves as required to balance system.
07 Test and record entering air temperatures, db and wb.
08 Test and record leaving air temperatures, db and wb.
09 Adjust all zones to design cfm (±2%).
10 Test and adjust each diffuser, grille, and register to within 5% of design.

C. AIR DUCT LEAKAGE: (From SMACNA Duct Standards latest edition) Test all ductwork (designed to handle over 1000 CFM) as follows:
01 Test apparatus
a. The test apparatus shall consist of:
b. A source of high pressure air - a portable rotary blower or a tank type vacuum cleaner.
c. A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.
02 Test Procedures
a. Test for audible leaks as follows:
1) Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
2) Start the blower with its control damper closed.
3) Gradually open the inlet damper until the duct pressure reaches 1.5 times the standard designed duct operating pressure.
4) Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.
b. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:
1) Start blower and open damper until pressure in duct reaches 50% in excess of designed duct operating pressure.
2) Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.
3) Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
4) Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which must be corrected.

D. DX SYSTEMS:
01 Test and record suction and discharge pressures at each compressor and record ambient air temperature entering the condensing coils.
02 Test and record unit full load amps and voltage.
03 Test and record staging and unloading of unit required by sequence of operation or drawing schedule.

E. Automatic temperature controls shall be calibrated; and all thermostats and dampers adjusted so that the control system is in proper operating condition, subject to the approval of the Engineer/Owner.

F. The TAB Contractor shall report to Engineer all air distribution devices or other equipment that operate noisily so that corrective measures may be implemented by the Contractor at no additional cost to the Owner or Architect/Engineer.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. External Duct Insulation
   01 Fiberglass / Glass Mineral Fiber Flexible Blanket Insulation
   02 Fiberglass / Glass Mineral Fiber Rigid Board Insulation
   03 Fiberglass / Glass Mineral Fiber Segmented Board Pipe and Tank Insulation
   04 Fiberglass / Glass Mineral Fiber Continuous Mat Pipe and Tank Insulation
   05 Fire-Rated High-Temperature Ceramic Fiber Flexible Blanket Insulation

B. Internal Duct Insulation
   01 Fiberglass / Glass Mineral Fiber Flexible Duct Liner Insulation
   02 Fiberglass / Glass Mineral Fiber Rigid Plenum Liner Insulation

C. Field-applied protective finishes

D. Adhesives

E. Mastics

F. Lagging Adhesives

G. Sealants

H. Glass Fiber Fabric Reinforcing Mesh

I. Securements

1.3 RELATED SECTIONS

A. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 23 05 53 - Identification for HVAC Piping and Equipment

C. Section 23 31 13 - Metal Ductwork

1.4 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2024b.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations; 2023.

F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

G. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.

H. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).

I. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks; 2019.

J. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).

K. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation; 2021.

L. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation; 2021.

M. ASTM D1644 - Standard Test Methods for Nonvolatile Content of Varnishes; 2001.

N. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.

O. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

P. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

Q. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

R. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

S. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

T. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

V. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

W. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

X. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria; 2023.

Y. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Z. MIL-DTL-3316 - Adhesives, Fire-Resistant, Thermal Insulation; 2020d.

AA. NACIIS - North American Commercial and Industrial Insulation Standards Manual; current edition.

BB. NAIMA FGDLS - North American Insulation Manufacturers Association (NAIMA) Fibrous Glass Duct Liner Standards; Current Edition, Including All Revisions.

CC. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

DD. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

EE. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

FF. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

GG. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers; Current Edition, Including All Revisions.

HH. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

II. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

B. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

01 Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

C. Duct and plenum insulation shall comply with minimum R-value requirements of ICC (IECC) and ASHRAE Std 90.1 I-P unless greater values are indicated otherwise in the contract documents.

D. Adhesive and other insulation materials shall comply with NFPA 90A and NFPA 90B. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

E. Vapor retarder mastics used on the interior of the building shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D

F. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

G. Fiberglass insulations shall have a minimum of 50 percent recycled glass content.

H. Fiberglass insulations shall be UL GREENGUARD Gold certified.

1.6 WARRANTY

A. Warrant the Work specified herein for one 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:
   01 Mildewing.
   02 Peeling, cracking, and blistering.
   03 Condensation on exterior surfaces.

1.7 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation materials to site in unopened containers with manufacturer’s product name, ASTM standard designation, type and grade, maximum use temperature, nominal dimensions, manufacturer lot or date code.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

C. Store insulation indoors and keep free from exposure to UV and precipitation.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.

B. A sample quantity of each type of insulation and each type of application shall be installed and approval secured prior to proceeding with the main body of the Work.

2.2 ACCEPTABLE MANUFACTURERS

A. Fiberglass/Glass mineral fiber materials shall be as manufactured by Knauf Insulation, Certain-Teed, Johns-Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor retarder, etc., as the types specified herein, subject to review by the Engineer.

B. Adhesives, mastics, and sealants shall be as manufactured by 3M Company, Carlisle/Hardcast, Design Polymerics, Foster/Childers, Mon-Eco Industries, or Vimasco Corporation and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

C. Ceramic fiber materials shall be as manufactured by 3M Company, Alkegen/Unifrax, or Morgan Advanced Materials/Thermal Ceramics.

D. Metal jacketing and fitting covers shall be as manufactured by Johns Manville or RPR Products, Inc.

2.3 EXTERNAL INSULATIONS

A. Fiberglass / Glass Mineral Fiber Flexible Blanket Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C1290 and ASTM C553, Type I, II, and III. Provide insulation with factory applied FSK vapor retarding facing complying with ASTM C1136, Type I, II, VIII, X. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.27 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 250 degrees F with facing, 350 degrees F for unfaced material. Provide Knauf Insulation Performance+ Duct Wrap with ECOSE Technology, Johns Manville Microlite FSK or approved equal.

B. Fiberglass / Glass Mineral Fiber Rigid Board Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C553 Type I, II, III, ASTM C612 Type IA, IB. Provide insulation with factory applied FSK facing vapor retarder facing complying with ASTM C1136, Type I, II. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.24 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 450 degrees F. Provide Knauf Insulation Earthwool Insulation Board with ECOSE Technology, Johns Manville 800 Series Spin-Glas or approved equal.

C. Fiberglass / Glass Mineral Fiber Segmented Board Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C1393, Category 1. Semi-rigid, segmented board in roll form with glass fibers adhered perpendicular to the vapor retarder facing. Provide insulation with factory applied FSK vapor retarder facing complying with ASTM C1136, Type II, IV, X. Compressive strength per ASTM C165 C165, not less than 120 PSF at 10% deformation. Thermal conductivity (k-value) at 100 degrees F mean temperature shall be 0.26 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 850 degrees F. Provide Knauf Insulation Earthwool Pipe & Tank Insulation with ECOSE Technology or approved equal.

D. Fiberglass / Glass Mineral Fiber Continuous Mat Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin, complying with ASTM C1393; Type I, II, IIIA, IIIB Category 2. Semi-rigid, continuous mat in roll form. Provide insulation with factory applied FSK vapor retarder facing complying with ASTM C1136, Type II, IV, X. Compressive strength per ASTM C165, not less than 25 PSF at 10% deformation. Thermal conductivity (k-value) at 100 degrees F mean temperature shall be 0.25 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 850 degrees F. Provide Knauf Insulation KwikFlex Pipe & Tank Insulation, Johns Manville Micro-Flex or approved equal.

E. Fire-Rated High-Temperature Ceramic Fiber Flexible Blanket Insulation: High-temperature ceramic fiber blanket thermal insulation encapsulated in a fiberglass reinforced aluminized polyester foil. Fire-rated blanket insulation shall have a nominal thickness of 1-1/2" and a nominal density of 6.0 pcf. Provide 3M Fire Barrier Duct Wrap 615+, Alkegen/Unifrax FyreWrap Elite 1.5, or Morgan Advanced Materials/Thermal Ceramics FireMaster FastWrap XL.

2.4 INTERNAL INSULATIONS

A. Fiberglass / Glass Mineral Fiber Flexible Duct Liner Insulation: Rotary glass fibers bonded with thermosetting resin, complying with ASTM C1071 Type I. Airstream side to have a tightly bonded, black mat finish withstanding maximum rated air velocity of 6,000 ft/minute. Mat finish shall be treated with EPA-registered biocide for use in HVAC systems and verified to be microbially resistant in accordance with ASTM G21, ASTM G22, ASTM C1338, and UL 2824. The outer edges of the Liner shall have a factory applied encapsulating coating. Nominal density shall be 1.5 pcf minimum and when tested in accordance with ASTM C423 (Type A Mounting), shall provide a Noise Reduction Coefficient of 0.70 at 1.0", 0.80 at 1.5", and 0.95 at 2.0" thickness. Maximum service temperature of 250 degrees F. Thermal Conductivity (k-value) at 75 degrees F mean temperature shall be 0.24 Btu x in. /h x sq. ft. x degrees F, or less. Provide Knauf Insulation Performance+ Duct Liner with ECOSE Technology, Johns Manville Linacoustic RC or approved equal.

B. Fiberglass / Glass Mineral Fiber Rigid Plenum Liner Insulation: Glass fibers bonded with thermosetting resin, complying with ASTM C1071 Type II. Airstream side to have a tightly bonded, black mat finish withstanding maximum rated air velocity of 5,000 ft/minute. Mat finish shall be treated with EPA-registered biocide for use in HVAC systems and verified to be microbially resistant in accordance with ASTM G21 and ASTM C1338. The outer edges of the Liner shall have a factory applied encapsulating coating. Nominal density shall be 3.0 pcf minimum and when tested in accordance with ASTM C423 (Type A Mounting), shall provide a minimum Noise Reduction Coefficient of 0.65 at 1.0", 0.85 at 1.5", at 0.95 at 2.0" thickness. Maximum service temperature of 250 degrees F. Thermal Conductivity (k-value) at 75 degrees F mean temperature shall be 0.23 Btu x in. /h x sq. ft. x degrees F, or less. Provide Knauf Insulation Performance+ Rigid Plenum Liner with ECOSE Technology, Johns Manville Linacoustic R-300 or approved equal.

2.5 FIELD-APPLIED PROTECTIVE FINISHES

A. METAL JACKETING: Provide aluminum jacketing complying with ASTM C1729 or stainless steel jacketing complying with ASTM C1767. Metal jacketing shall have a minimum thickness of 0.016 inches.

2.6 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Fiberglass / Glass Mineral Fiber Adhesive: Comply with MIL-DTL-3316C, Class 2, Grade A. Provide Childers CP-82 or approved equal.

C. Duct Liner Adhesive: Duct Liner adhesives shall comply with ASTM C916.

2.7 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor and outdoor use on below ambient services. Water-Vapor Permeance shall be 0.09 perms at 55-mils dry film thickness when tested in accordance with ASTM E96/E96M, Procedure A. Service Temperature Range shall be -20 to +180 degrees F. Solids content shall be 59 percent by volume and 71 percent by weight per ASTM D1644. Provide Childers CP-35 or approved equal.

2.8 LAGGING ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation. Service Temperature Range shall be 0 to +180 degrees F. Provide Childers CP-52 or approved equal.

2.9 SEALANTS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. FSK and Metal Jacket Flashing Sealants shall be fire and water-resistant, flexible, elastomeric sealants with a service temperature range of -40 to +250 degrees F. Provide Childers CP-76 or approved equal.

C. Fire Barrier Sealant shall be a latex-based, intumescent sealant that dries to form a monolithic firestop seal. Fire barrier sealant shall be firestop tested up to 4 hours in accordance with ASTM E814 and fire resistance tested in accordance with ASTM E1966. Provide 3M CP 25WB+ or approved equal.

2.10 GLASS FIBER FABRIC REINFORCING MESH

A. Woven Glass Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch. Provide Childers Chil-Glas No. 10 or approved equal.

2.11 SECUREMENTS

A. Bands
   - 01 Approved Manufacturers
     - a. Johns Manville
     - b. RPR Products
   - 02 Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
   - 03 Aluminum: ASTM B209/B209M, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
   - 04 Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins

01 Approved Manufacturers
   a. AGM Industries, Inc.
   b. Midwest Fasteners, Inc.
   c. GEMCO
   d. Duro-Dyne

02 Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

03 Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, minimum 0.106-inch-diameter shank, length to suit depth of insulation indicated.

04 Insulation Retaining Washers: Self-locking washers formed from 0.016 inch thick, galvanized steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Staples

01 Outward-clinching insulation staples, nominal 1/2-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 GENERAL

A. To ensure that external fiberglass/glass mineral fiber flexible blanket and rigid board insulation will achieve its highest possible performance and serve its intended purpose, install all mechanical insulation materials and associated accessories in accordance with manufacturer’s published instructions and industry practices detailed by the NACIIS Manual as published by the Midwest Insulation Contractors Association (MICA).

B. To ensure that internal fiberglass/glass mineral fiber flexible duct and rigid plenum liner insulation will achieve its highest possible performance and serve its intended purpose, install duct liner, plenum liner, and all associated accessories in accordance with manufacturer’s published instructions and industry practices detailed by NAIMA FGDLS and SMACNA (DCS).

C. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of, ducts and fittings.

E. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

3.2 EXTERNAL DUCT INSULATION

A. Fasten all longitudinal and circumferential laps with outward clinching staples 3" on center. On rectangular ducts over 24" wide apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12" centers.

B. Seal all joints, fastener penetrations and other breaks in vapor retarder with 3-inch wide strips of glass fiber fabric reinforcing mesh embedded between two coats of vapor retarder mastic.

C. External duct wrap is required on all outside air ducts, supply and return air ducts that are not internally insulated. External duct wrap is also required on all exhaust and relief air ducts that are used in airside energy recovery systems. Any exhaust ductwork located in an unconditioned space that conveys air from conditioned spaces or vice versa shall also be provided with external duct wrap. Duct wrap shall be provided as follows:
   01 1½" thick, 1.0 pcf density minimum; minimum installed R-value of 4.5 when ducts are located in directly conditioned spaces.
   02 2" thick, 1.0 pcf density minimum; minimum installed R-value of 6.0 when ducts are located in indirectly conditioned spaces such as ceiling plenum space used for return air or located indoors concealed within chases or shafts.
   03 3" thick, 0.75 pcf density minimum; minimum installed R-value of 8.3 when ducts are located in unconditioned spaces.

D. Any ductwork located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E84 or UL 723 testing requirements or UL 2043 for discrete products in plenums shall be provided with a single layer of duct wrap to establish a noncombustible rating per ASTM E136. Duct wrap products which are approved for such non-compliant combustible duct materials located in air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Alkegen/Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

3.3 DUCT LINER

A. Duct liner shall be kept clean and dry during transportation, storage, installation, and throughout the construction process care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.

B. Duct liner shall be adhered to the sheet metal with a full coverage of approved adhesive complying with ASTM C916. All exposed leading edges and transverse joints shall be coated with factory-applied or field-applied edge coating, Childers CP-50A HV2 Black or approved equal and shall be neatly butted without gaps. Shop or field cuts shall be liberally coated with an edge coating. All coatings and adhesives shall be designed for duct liner application.

C. Metal nosings shall be securely installed over transversely oriented liner edges facing the airstream at forward discharge and at any point where lined duct is preceded by unlined duct.

D. When velocity exceeds 4,000 fpm (20.3 m/sec), use metal nosing on every leading edge. Nosing may be formed on duct or be channel or zee attached by screws, rivets or welds.

E. Secure duct liner with mechanical fasteners that are adhered, weld-secured or impact-driven to hold to the duct metal, with retaining washers or integral cupped heads. Provide a minimum of 1 row of pins per duct side. Pin according to NAIMA FGDLS pinning schedule.

F. Line supply and return ductwork at connection of fan-powered HVAC units to a point of 15 feet upstream and downstream of the equipment, 15 feet downstream of fan powered terminal units, and in return air boots.

G. Duct liner shall be provided as follows:
   01 1" thick, 1.5 pcf density minimum, with a minimum installed R-value of 4.2 when ducts are located in directly conditioned spaces.

02 1 ½” thick, 1.5 pcf density minimum, with a minimum installed R-value of 6.0 when ducts are located in indirectly conditioned spaces such as ceiling plenum space used for return air.

03 2” thick, 1.5 pcf density minimum, with a minimum installed R-value of 8.0 when ducts are located in indoor, unconditioned spaces or located outdoors.

04 1 ½” thick, 3.0 pcf density minimum, with a minimum R-value of 6.3 for rigid plenum liner applications.

3.4 EXPOSED DUCTWORK LOCATED INDOORS

A. Duct required to be insulated by any section of this specification that is routed exposed in occupied spaces shall be double wall.

B. Duct routed exposed shall be double wall with perforated inner liner and fiberglass/glass mineral fiber insulation. Provide 1” thick insulation when ductwork is located in conditioned spaces and 2” thick in unconditioned spaces, insulation density shall be a minimum of 1.0 pcf. Double wall duct shall be United McGill model Acousti-k27 for round or oval ducts and Rectangular-k27 for rectangular ducts or approved equal.

3.5 AIR DEVICE AND MISCELLANEOUS DUCT INSULATION

A. The backside of all supply air devices shall be insulated with taped and sealed external duct wrap matching the thickness, density, and R-value of the associated duct system.

B. The contractor shall install an additional layer of 1-½ inch thick external fiberglass / glass mineral fiber duct wrap on any portion of the supply air, return air, outside air, or exhaust air system that has condensation forming during any period of operation. The insulation shall be taped and vapor-sealed and located until all evidence of the condensation has been eliminated, at no additional cost to the Owner.

3.6 FIRE RATED ASSEMBLY PENETRATIONS

A. Terminate insulation at fire damper sleeves for fire rated assembly penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

B. Seal penetrations through fire rated assemblies with an approved fire barrier sealant. Refer to Division 7 for further requirements regarding “"Through-Penetration Firestop Systems”.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 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.

B. Furnish and install piping insulation to:
   01 Condensate drain piping.
   02 Refrigerant piping.
   03 All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.
   01 Painting.
   02 Pipe hangers and supports.

D. For insulation purpose piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer well, unions, reducing stations, and orifice assemblies.

1.3 RELATED SECTIONS

A. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

B. Section 23 05 53 - Identification for HVAC Piping and Equipment

C. Section 23 21 13 - Above Ground Hydronic Piping

D. Section 23 23 00 - Refrigerant Piping

1.4 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).

D. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.

E. ASTM C1617 - Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals; 2019.

F. ASTM C1710 - Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form; 2022.

G. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation; 2021.

H. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation; 2021.

I. ASTM D1644 - Standard Test Methods for Nonvolatile Content of Varnishes; 2001.

J. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

K. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).

L. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

M. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

N. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

O. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

Q. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

R. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

S. MIL-A-24179 - Adhesive, Flexible Unicellular-Plastic Thermal Insulation; 1969a (Validated 2020).

T. MIL-DTL-3316 - Adhesives, Fire-Resistant, Thermal Insulation; 2020d.

U. NACIIS - North American Commercial and Industrial Insulation Standards Manual; current edition.

V. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

W. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

X. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

Y. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

Z. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

B. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.
   01 Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

C. All HVAC piping insulation thicknesses shall comply with ICC (IECC) and ASHRAE Std 90.1 I-P.

D. Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above. Additionally, all adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) shall be comprised of low-emitting materials that comply with VOC limits prescribed by SCAQMD 1168.

E. Adhesives, mastics, and sealants used on the interior of the building shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D

F. All insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

G. All insulations shall be UL GREENGUARD Gold certified.

H. Insulation materials applied to carbon steel shall be Mass Loss Corrosion Rate (MLCR) tested per ASTM C1617.

I. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

J. Fiberglass insulations shall have a minimum of 50 percent recycled glass content.

K. Foam insulation materials shall be manufactured without the use of chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) blowing agents.

1.6 WARRANTY

A. Warrant the Work specified herein for one 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:
   01 Mildewing.
   02 Peeling, cracking, and blistering.
   03 Condensation on exterior surfaces.

1.7 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.8 DELIVERY AND STORAGE

A. Deliver insulation materials to site in unopened containers with manufacturer's product name, ASTM standard designation, type and grade, maximum use temperature, nominal dimensions, manufacturer lot or date code.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove such from project site.

C. Store insulation indoors and keep free from exposure to UV and precipitation.

PART 2 - PRODUCTS

2.1 HVAC PIPING INSULATION

A. It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

B. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and reviewed prior to installation.

C. A sample quantity of each type of insulation and each type application shall be installed and accepted prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

D. Any existing piping located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E84 testing requirements shall be provided with a single layer of high-temperature insulation to establish a noncombustible rating per ASTM E136. Insulation products which are approved for such non-compliant combustible piping materials located air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

2.2 APPROVED MANUFACTURERS

A. Adhesives, mastics, and sealants shall be as manufactured by 3M Company, Armacell, Foster/Childers, Mon-Eco Industries, or Vimasco Corporation and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

B. Flexible elastomeric cellular thermal insulation shall be as manufactured by Armacell.

C. Phenolic foam insulation shall be as manufactured by Resolco, Inc. (Insul-Phen) or Polyguard (Poly-phen).

D. Metal jacketing and fitting covers shall be as manufactured by Johns Manville or RPR Products.

2.3 MATERIALS

A. CONDENSATE DRAINAGE PIPING: Provide flexible elastomeric cellular thermal insulation in accordance with ASTM C534/C534M. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.276 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 230 degrees F. Provide model "Armaflex Ultima", fire rated for use in environmental air plenums; insulation not required when piping is exposed on roof.

B. REFRIGERANT PIPING: Provide flexible elastomeric cellular thermal insulation in accordance with ASTM C534/C534M. Provide model "Armaflex Ultima", fire rated for use in environmental air plenums for all indoor applications. Thermal conductivity (k-value) at 75 degrees F mean temperature shall be 0.276 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 230 degrees F. Provide model "AP Armaflex", with secured metal jacketing for all outdoor applications.

C. FACTORY-APPLIED VAPOR RETARDERS - ALL SERVICE JACKETING (ASJ+): Vapor retarder jacket for interior applications shall be composed of an aluminum foil layer, reinforced with glass scrim, bonded to a layer of white kraft paper, interleaving with an outer polymer film leaving no paper exposed; complying with ASTM C1136.

D. FIELD-APPLIED PROTECTIVE FINISHES

01 METAL JACKETING: Provide aluminum jacketing complying with ASTM C1729 or stainless steel jacketing complying with ASTM C1767. Metal jacketing shall have a minimum thickness of 0.016 inches for piping sizes through 6” diameter, 0.020” for piping sizes 8” diameter through 10” diameter, and 0.024” for piping sizes 12” diameter through 24” diameter. Provide pre-formed fitting covers for all elbows and tees.

E. HIGH DENSITY INSERTS

01 Provide high density inserts at all pipe support locations as indicated herein to prevent excessive compression of the insulation. High density inserts shall have a minimum compressive strength of 100 psig. Pipe supports shall either be noncombustible, or be UL listed and labeled in accordance with UL 2043. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required. Refer to 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC .

02 Provide 360° high density inserts at all pipe support locations for fiberglass insulation applications. High density inserts shall be calcium silicate for fiberglass insulation applications.

03 Provide 180° high density inserts at all pipe support locations for phenolic foam insulation applications for piping 4.0” diameter or larger. High density inserts shall be phenolic foam insulation meeting the compressive strength requirements indicated herein.

04 Provide 360° high density inserts at all pipe support locations for flexible elastomeric cellular thermal insulation applications. Provide ArmaFix EcoLight or equal.

2.4 INSULATING CEMENTS

A. Mineral Fiber Insulating Cement: Comply with ASTM C195.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor and outdoor use on below ambient services. Water-Vapor Permeance shall be 0.09 perms at 55-mils dry film thickness when tested in accordance with ASTM E96/E96M, Procedure A. Service Temperature Range shall be -20 to +180 degrees F. Solids content shall be 59 percent by volume and 71 percent by weight per ASTM D1644. Provide Childers CP-35 or approved equal.

2.6 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F. Provide Childers CP-97 or approved equal.

C. Fiberglass / Glass Mineral Fiber Adhesive: Comply with MIL-DTL-3316C, Class 2, Grade A. Provide Childers CP-82 or approved equal.

D. Flexible elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I. Provide Armacell Armaflex 520 BLV or approved equal.

2.7 LAGGING ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation. Service Temperature Range shall be 0 to +180 degrees F. Provide Childers CP-52 or approved equal.

2.8 SEALANTS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Metal Jacket Flashing Sealants shall be fire and water-resistant, flexible, elastomeric sealants with a service temperature range of -40 to +250 degrees F. Provide Childers CP-76 or approved equal.

C. Fire Barrier Sealant shall be a latex-based, intumescent sealant that dries to form a monolithic firestop seal. Fire barrier sealant shall be firestop tested up to 4 hours in accordance with ASTM E814 and fire resistance tested in accordance with ASTM E1966. Provide 3M CP 25WB+ or approved equal.

2.9 GLASS FIBER FABRIC REINFORCING MESH

A. Woven Glass Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch. Provide Childers Chil-Glas No. 10 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. To ensure that external fiberglass/glass mineral fiber flexible blanket and rigid board insulation will achieve its highest possible performance and serve its intended purpose, install all mechanical insulation materials and associated accessories in accordance with manufacturer's published instructions and industry practices detailed by the NACIIS Manual as published by the Midwest Insulation Contractors Association (MICA).

B. All insulation shall be installed in accordance with the manufacturer's recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

D. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

E. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of pipe and fittings.

F. All heat recovery piping between air conditioning equipment and hydronic or domestic hot water piping shall be insulated per the High Temperature Surfaces Schedule below.

G. All condenser water piping located in a ceiling plenum shall be insulated per the requirements for indoor chilled water piping as indicated in the Low Temperature Surfaces Schedule below.

H. Pipes located outdoors, in crawlspaces, or in tunnels shall be insulated same as concealed piping and be provided with metal jacketing with longitudinal 1/2" safety hem and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. Jacket securement shall be by metal banding with clips. Banding material shall match jacketing material. Galvanized steel banding is not acceptable.

I. All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.

J. Installation of flexible elastomeric foam insulation shall be in accordance with ASTM C1710.

K. Provide all HVAC piping insulation to comply with the ASHRAE Std 90.1 I-P Minimum Thickness Schedule and as indicated below.

01 Minimum Insulation Thickness for Low Temperature Surfaces
- a. Condensate drain lines: 1 inch
- b. Refrigerant Piping
  - 1) 1½" and smaller: 1 inch
  - 2) Larger than 1½ inch: 1-½ inch

02 Minimum Insulation Thickness for High Temperature Surfaces
- a. Refrigerant Piping
  - 1) 1-½ inch and smaller: 1-½ inch
  - 2) Larger than 1-½ inch: 2 inch

3.2 WATER PIPE INSULATION INSTALLATION

A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 12 feet on straight runs, a vapor dam shall be formed between the vapor retarder jacket and the bare pipe. The seal shall be by the applications of vapor retarder mastic to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated fiberglass / glass mineral fiber covers finished with two brush coats of vapor retarder mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the joint is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder mastic shall be applied to all edges of the vapor retarder jacket.

D. At hangers and supports, provide a high-density insulation insert that extends 2" beyond the insulation shield on each side and a protective shield/saddle to prevent excessive compression/damage. Secure shield/saddle to insulation using mastic. Refer to 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC.

3.3 FIRE RATED ASSEMBLY PENETRATIONS

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying rock mineral fiber insulation in the annular space between the pipe and its associated sleeve.

B. Seal penetrations through fire rated assemblies with an approved fire barrier sealant. Refer to Division 7 for further requirements regarding “"Through-Penetration Firestop Systems”.

C. All fire stopping material shall be installed in accordance with manufacturer's printed instructions.

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 RELATED SECTIONS:

A. Section 23 09 63 - Energy Management and Control System (EMCS)

1.3 SUMMARY

A. The commissioning of the HVAC system and associated controls shall be performed by an impartial technical firm hired by the owner. The commissioning provider shall be certified under one or more of the following certifications:
   01 CxA - Certified Commissioning Authority - ACG
   02 CBCP - Certified Building Commissioning Professional - AEE
   03 CCP - Certified Commissioning Professional - BCA
   04 CPMP - Certified Process Management Professional - ASHRAE
   05 BSC - Building System Commissioning Certification - NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.4 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as related to the Commissioning Process include, but are not limited to the following:
   01 Facilitate coordination of Commissioning work by Commissioning authority.
   02 Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
   03 Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
   04 Provide all documentation relating to manufacturer’s recommended performance testing of equipment and systems.
   05 Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.
   06 Provide Testing and Balancing Report before Functional Testing begins.
   07 Provide As-built drawings and documentation to facilitate Testing.
   08 Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.
   09 Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.

10 Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and Pre-Functional Checklists.
11 Provide data concerning performance, installation, and start-up of systems.
12 Provide copy of manufacturers filled-out start-up forms for equipment and systems.
13 Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority **written** certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.
   a. Contractor shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.
   b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.
14 Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.
15 Provide qualified personnel to assist and participate in Commissioning.
16 Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.
17 Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Test Engineer in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
18 Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.
19 Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.
20 Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.
21 Prepare and submit to Commissioning authority proposed Training Program outline for each system.
22 Coordinate and provide training of Owner's personnel.
23 Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority comments.
24 Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning authority proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority

1.5 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:
   01 Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.

02 Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.

03 Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.

04 Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications. Testing shall include all modes and sequence of operation, including under full-load, part-load and emergency conditions (including all alarms). Controls system shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with the plans and specifications. Sequences shall be functionally tested to document they operate in accordance with plans and specifications.

05 Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.

06 Air and hydronic system balancing: Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the contract documents. System balancing shall be performed by TAB contractor as specified in 23 05 93 - Testing, Adjusting, And Balancing.

07 Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.

08 Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Equipment to be tested

01 Energy Management and Control System:

a. Graphical User Interface

b. Automation Software

c. Field Level Controllers

d. Field Level Devices

e. Control Sequences

02 Air Handling Systems (All AHU and 10% of terminal units)

03 Energy Recovery Systems (100%)

C. Testing functions and conditions

01 Energy conservation programs (economizer, optimal start, etc)

02 Verify shutdown of systems when scheduled.

03 Calibration of sensors

04 Testing shall affirm winter and summer design conditions.

05 Test under full outside air conditions.

06 Confirm functionality of all specified sequences of operations.

07 Verify the functionality of all alarms.

D. Performance criteria

01 Air and water temperatures shall be within tolerances specified in the contract documents.

02 Space temperatures shall be maintained within 1 degree of specified set points.

03 Space humidity shall be maintained within 5% of specified levels.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 - EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced, tested, and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist commissioning authority with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of 7 days prior to date of system startup, submit to Commissioning authority for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor's responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division's systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

C. Refer to commissioning plan for detailed list of equipment to be commissioned.

D. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

E. DBR has included a small contingency for limited retesting, however DBR reserves the right to stop testing on a system when the system:
   01 Does not have the correct graphics programmed.
   02 Does not have the correct data trends programmed.
   03 Does not have the correct set points programmed.
   04 Does not have the equipment or system safeties installed and programmed correctly.
   05 The TAB data forms have not been submitted to our firm or the performance of the system listed on the TAB forms is not per project requirements.
   06 Line items of the functional performance test have failed.

F. Sampling
   01 Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.
   02 Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
   03 A common sampling strategy is the "xx% Sampling - yy% Failure Rule", defined by the following example.
      a. xx = the percent of the group of identical equipment to be included in each sample.
      b. yy = the percent of the sample that if failing, will require another sample to be tested.
      c. The example below describes a 20% Sampling - 10% Failure Rule.
      d. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the "first sample."

e. If 10% (yy) of the units in the first sample fail the functional tests, test another 20% of the group (the second sample).
f. If 10% of the units in the second sample fail, test all remaining units in the whole group.
g. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

G. Re-Testing And Failure To Remedy Deficiencies

01 Despite Contractor's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.

02 It is Contractor's responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.

03 It is Contractor's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.

a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond Contractor's control to resolve expeditiously.
b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

04 CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor's request.

a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, Contractor will be back-charged for CxA's expenses, and time at a rate of $150.00 per hour and $100.00 expenses, for a third and any subsequent re-inspections and re-tests.

H. Deferred Testing

01 "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.

02 If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.

03 GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.

04 Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.

05 Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.

06 GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

D. Commissioning authority shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning authority with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Sub-Contractor shall compile and prepare documentation for equipment and systems specified in this Division, and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority copy of O&M manuals shall be submitted through Architect.

D. Operation and maintenance manuals shall include, service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:
   01 Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.

02 Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION

SECTION 23 09 63

ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS)

PART 1 - GENERAL

1.1 GENERAL

A. The Energy Management and Control System (EMCS) shall be comprised of a Local Area Network (LAN) infrastructure, Operator Workstations (OWS), Engineering Workstations (EWS), a Primary Network Server (PNS), Network Area Controllers (NAC), Application Specific Controllers (ASC), Unitary System Controllers (USC), and Field Devices installed within the facility. The EMCS Contractor shall provide a completely wired system. Wireless components and wireless communication are not acceptable.

B. The Workstations, Primary Network Server, and Network Area Controllers shall be connected by a EMCS Contractor supplied and installed Local Area Network. The LAN shall comply with all IEEE Standards as outlined in the latest revision of IEEE 802: Local and Metropolitan Networks: Overview and Architecture.

C. If the EMCS contractor wishes to connect to the Owner's Wide Area/Local Area Network as part of the control system network, the EMCS contractor shall acquire permission in writing and include the letter in the submittal. Any system that requires connection to the owner's network for communication between NAC, ASC, USC and/or field devices that is submitted without the written permission from the owner shall be rejected. The EMCS Contractor shall coordinate with the Owner and supply all required information.

D. Access to the system, either locally in the building, or remotely from a central site or sites, shall be accomplished through standard web browsers, via the Internet and/or a local area network.

E. All EMCS controllers and workstations shall communicate using the protocols and network standards as defined by ASHRAE Std 135, latest revision. Management level TCP/IP Ethernet network speeds shall be 1 Gbps minimum and the Automation Level MS/TP network speeds shall be 76.8 Kbps minimum.

F. The Server shall gather data from the system and generate HTML pages accessible through a conventional web browser from all personal computers (PCs) connected to the network. System shall include any and all software and hardware to support at least 50 simultaneous users. The EMCS shall be compatible with all common web browsers.

G. Facility Operators shall be able to view and configure systems through the standard web browser and all graphical/data representations shall appear identical, whether the user is on site or viewing via the Internet at a remote location. Standard operator functions such as control point manipulation, configuration and viewing of trends, schedules and alarms shall be performed through the standard browser. Each mechanical system and building floor plan shall be depicted on the operator workstation by point-and-click graphics.

H. The EMCS shall directly control HVAC equipment as specified in the Sequence of Operations. Furnish Energy Conservation features such as Optimal Start/Stop, Night Setback, Setpoint Reset logic, and Demand Control Ventilation.

I. The EMCS vendor shall provide the following additional services as part of this specification: warranty and service during the warranty period; submittals, samples and record documentation; comprehensive startup and testing of the EMCS with documentation; training services for the owner and facility operators; coordination with other contractors and suppliers; operator and technician training program, and shall cooperate fully with the Project Commissioning Agent.

J. Products furnished under this specification but installed by others.
   01 Mechanical devices installed under Division 23 by the mechanical contractor or other suppliers:
      a. Temperature sensing thermowells.
      b. Automatic control valves and actuators.
      c. Automatic control dampers and actuators not installed in air handling unit mixing boxes or louvers.
      d. Damper actuators for automatic control dampers installed in air handling unit mixing boxes.
   02 Electrical devices installed under Division 26 by the electrical contractor:
      a. 120 VAC power to controllers and control panels at locations indicated on the drawings. Review and verify that these locations are adequate for the proposed EMCS.
      b. Interlock wiring to duct mounted smoke detector or fire alarm shutdown relays to HVAC equipment motor starters and variable frequency drives (VFD).

K. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.

1.2 RELATED DOCUMENTS & REFERENCES

A. Drawings and general provisions of the contract documents, apply to this section including:
   01 Division 01 for General Conditions and Supplementary Conditions.
   02 Division 21 for fire protection equipment.
   03 Division 22 for plumbing equipment and domestic water systems.
   04 Division 23 for mechanical equipment, ductwork, and piping systems.
   05 Division 26 for electrical equipment, lighting control, and fire alarm systems.

B. The latest edition of the following standards and codes in effect as approved by the authority having jurisdiction and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
   01 ANSI MC85.1 - Terminology for Automatic Control.
   02 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   03 ASHRAE Std 135 - BACnet.
   04 BTL Mark by the BACnet Testing Laboratories.
   05 Uniform Building Code (UBC), including local amendments.
   06 UL 916 - Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
   07 NFPA 70, National Electrical Code (NEC).
   08 FCC Part 15, Subpart J, Class A.
   09 National Institute of Standards and Technology (NIST).
   10 IEEE 802: Local and Metropolitan Networks: Overview and Architecture.

1.3 RELATED WORK IN OTHER SECTIONS

A. Refer to Division 00 and Division 01 for allowances and related contractual requirements.

B. Refer to Division 21 for General Fire Protection Provisions and fire suppression pump.
   01 The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP is acceptable if IP interface is not available from equipment manufacturer.
   02 The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

C. Refer to Division 22 for General Plumbing Provisions, domestic water heating systems, domestic water pumping systems, domestic water metering, and natural gas metering.
   01 The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP is acceptable if IP interface is not available from equipment manufacturer.
   02 The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

D. Refer to Division 23 for General Mechanical Provisions for equipment such as chillers, cooling towers, boilers, pumps, air-handling units, terminal units, ventilation fans, variable frequency drives, unitary AC units, etc.
   01 The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP is acceptable if IP interface is not available from equipment manufacturer.
   02 The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

E. Refer to Division 26 for General Electrical Provisions for equipment such as electrical switchgear control, electrical power monitoring, emergency generators, lighting control system, etc.
   01 The EMCS contractor shall provide communications integration via BACnet/IP interface to each installed system listed above. BACnet MS/TP is acceptable if IP interface is not available from equipment manufacturer.
   02 The EMCS contractor shall coordinate with all vendors providing above systems to obtain communications requirements and points lists. Map all available points to EMCS.

1.4 ELECTRICAL POWER PROVISIONS

A. Primary power will be provided under Division 26 by the electrical contractor to the panel locations indicated on the mechanical & electrical drawings. Provide step down transformers within panel enclosures. Provide all necessary fuses and circuit protection devices.

B. Power will be provided to the controllers serving fan powered terminal units with electric heat via the control transformer provided with the unit.

C. All components of the EMCS shall be powered from the sources above. Provide final terminations from the locations indicated on the Division 23 Drawings.

D. The EMCS Contractor shall provide any additional control power that is required as part of this contract and not indicated by other. This shall include all conduit, cabling, circuit breakers, etc.

E. Controllers must remain powered even if the equipment they control is disabled. If hardwired interlocks or relays could interrupt controller power, the controllers shall use an independent power circuit to ensure continuous reporting to the EMCS.

1.5 CONTRACTOR QUALIFICATIONS

A. The EMCS Contractor shall:
   01 Have a local staff of trained personnel capable of giving instructions and providing routine and emergency maintenance on the EMCS, all components and software/firmware and all other elements of the EMCS.
   02 Have a proven record of experience in the supply and installation of equivalent BACnet systems over a minimum period of five years. Provide documentation of at least three equal and complexity, if so requested by the Owner's Representative.
   03 Be a factory certified representative of the native BACnet EMCS manufacturer for design, installation, and service of the proposed system.
   04 Have comprehensive local service, training and support facilities for the total EMCS as provided. Maintain local, supplies of essential expendable parts.

1.6 SUBMITTALS

A. ALL DOCUMENTS SUBMITTED SHALL BE IN NATIVE PDF FORMAT. NO SCANS.

B. Shop Drawings:
   01 The following information shall be included on the cover page for each shop drawing and equipment documentation submittal:
      a. Project name with date. Refer to the applicable specifications by name and number.
      b. Provide submittal number and re-submittal number and date as applicable.
      c. Provided name and address of Consulting Engineer, Mechanical Contractor, General Contractor
   02 Shop drawings shall be CAD generated, plot size of 8-1/2" x 11" or 11" x 17". Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed.
   03 Provide schematic of systems indicating instrumentation locations, all interconnecting cables between supplied cabinets on a mechanical floor plan.
   04 Software specifications and descriptions including operating sequences.
   05 Provide a bill of material that indicates specific manufacturer, part number, part description and quantity of each device for all system components.
   06 Provide a list of the wire labels to be installed on each end of the control wiring, at the device and the control panel terminal. Labels shall be machine generated, typed and legible with a maximum of 17 characters. The label description "AHU-1 SAT" shall indicate the supply air temperature of AHU-1.
   07 Equipment Schematic: Provide an electronic equipment schematic for each piece of mechanical equipment. The schematic shall display all mechanical equipment characteristics including fans, dampers, valves, sensors and other applicable control devices. The schematic shall show wiring terminations to each control device as shown in the submittal and as-build documentation. Control devices shall be labeled by a symbol that can easily be identified in a bill of material that is shown on this graphic. The bill of material shall show the device symbol, description, manufacturer and part number.
   08 Sequence of Operations: The control sequences shall be viewable for each piece of mechanical equipment and be in a text format as shown in the as built documentation. The sequence of operations shall be selectable at the applicable location for the control program.

C. Control component submittals:
   01 Component technical data sheets with mounting and installation details.
   02 The documentation shall include comprehensive and complete details of the BIBB and automation level documentation including address, associated controller type, etc. as required and for the interface to the EMCS.
   03 Details of networks/communications equipment, cabling and protocols proposed. Provide schedule of cabling including details of proposed cable types.
   04 Module Drawing: Provide an electronic wiring diagram of each control module (as shown in submittal documentation). Diagram shall display wiring schematic and terminations to end devices. Diagram shall display each input and output terminals and label those that are used for the control application. Diagram shall display module type/name and network address.
   05 Field sensor and instrumentation specification sheets. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
   06 Schedule and specification sheets for dampers, valves and actuators.
   07 Design and provide layout of all components of panel mounted control devices, terminal strips and power supplies.

D. Colorgraphics: Provide sample layout of color graphic representations of the systems for review. The submittal shall indicate the quality of the graphic to be provided with the system with a sample of the specific control points to be included. Control points shall as a minimum include points indicated in the input/output summary, control schematic and primary controlling points defined in the sequences of operation. Provide a sample of a floor plan layout, typical AHU, terminal unit, outside air pretreatment unit, variable frequency drive, exhaust/supply fan, chiller plant and hot water plant. For control points to be provided by equipment BACnet integration provide sample of the control points, up to 25 total.

E. Verification Reports: The submittal shall include a sample of the verification reports to be utilized during the verification section of this specification. Sample reports shall be approved as submitted or be modified by the engineer or owner's representative. The verification reports shall be included in the final Operation & Maintenance Manuals. Reports shall be provided in electronic PDF format.
   01 Project Systems Verification Form for each controller.
      a. General information for each form shall include: project name; associated equipment with mark number; control panel number and location; controller number and model number; controller device instance number (address); MS/TP LAN segment number; verifying technician and date.
      b. Each connected control point and device shall contain the following columns with a separate line for each connected physical point: point description (same as device label); input/output number for each connected control device (AI-XX, AO-XX, DI-XX, or DO-XX).
      c. Check boxes confirming that the verification tasks have been completed: device location, proper termination at device; proper termination at control panel; sequence is verified; point trend is enabled.
      d. Data entry boxes indicating measured/confirmed values: preliminary control point value on the graphic; observed control point value; calibration or adjustment value to correct offset; final displayed point value on the color-graphic; date of verification; engineer or owner's representative verification.
   02 Control Panel Verification Form for each control panel.

a. General information: panel location and identification number; panel dimensions and NEMA rating; panel properly installed; Class 1 and Class 2 wiring are properly separated; correct voltage to the panel; no shorts or grounds in panel; no induce voltages in panel wiring; point to point termination match submittal; devices are mounted in the correct location; controller software revision number; address of controllers; panel device checkout is complete; panel startup is complete.

03 Sequence of Operation Verification Form per piece of equipment (AHU, VAV, chiller, boiler, etc.).

a. General information: project name; system identifier; building area served; control panel and controller numbers; controller model number and instance number (address); MS/TP LAN segment number; name of verifying technician and date.

b. Each step of the sequence of operation for each piece of equipment shall be documented shall include a “description of test”, “input to trigger test” and “expected outcome”. A pass/fail checkbox shall indicate each of these actions. Provide space for technician approval with associated date.

F. Operating and Maintenance (O&M) manuals: Provide O&M manual with full information to allow the owner to operate, maintain and repair installed products. Include trade names with model numbers, color, dimensions and other physical characteristics.

01 Format: Produce on 8-1/2 x 11-inch pages, and bind in 3-ring/binders with durable plastic covers. Label binder covers with printed title “OPERATION AND MAINTENANCE MANUAL”, title of project, and subject matter and “Number _ of _” of binder. Provide substantial dividers tabbed and titled by section/component number.

02 Table of Contents for each volume:

a. Part 1: Directory with name, address and telephone number of Designer, Contractor and Subcontractors and Suppliers for each Project Manual section.

b. Part 2: Operation and maintenance instructions, arranged by Project Manual Section number where practical and where not, by system. Include:

03 Product design criteria, functions, normal operating characteristic and limiting conditions. Installation, alignment, adjustment, checking instructions and troubleshooting guide. Operating instructions for start-up, normal operation, regulation and control, normal shutdown and emergency shutdown. Test data and performance curves.

04 Spare parts list for operating products, prepared by manufacturers including detailed drawings giving location of each maintainable part, lists of spares recommended for user- service inventory and nearest source of in-stock spares.

G. Record Documentation:

01 Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.

02 Detail special programs provided and provide a complete programming instruction manual. Detail operation of all software applications.

03 Detailed list of the database for all installed devices.

04 Record drawings shall be CAD generated and shall include final locations and point ID for each monitored and controlled device.

05 In additional to the required hard-copies, provide a CD-ROM with all of the record documentation in PDF format and a CD-ROM containing backup copies of all installed software and graphics.

06 Online as-built documentation: provide digital replications of as-builts that shall be accessible from each equipment graphic controlled or monitored by the EMCS.

1.7 WARRANTY

A. Warranty work and the equipment provided under this contract shall be for a period of one year from the date of Substantial Completion. Warranty shall cover all components, system software, parts and assemblies supplied by this contractor and shall be guaranteed against defects in materials and workmanship for one (1) year from the date of Substantial Completion. Labor to troubleshoot, repair, reprogram or replace system components that have failed due to defects in materials and workmanship shall be provided by this contractor at no charge to the owner during the warranty period. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks. All warranty work shall be performed by the EMCS contractor's local service group.

B. Warranty shall not include routine maintenance, e.g., equipment cleaning, mechanical parts lubrication, pilot lamp replacement, operational testing, etc. Warranty shall not cover repair or replacement of equipment damaged by under- or over-voltage, misuse, lack of proper maintenance, lightning, water damage from weather or piping failure.

C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the EMCS contractor. The maximum acceptable response time to provide this service at the site shall be 24 hours, during normal working hours.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration that includes hands-on demonstration of the manipulation of setpoints, schedules and other adjustable elements of the system.
   07 The demonstration shall be on the actual, completed graphic interface pages for the specific project.

B. Provide a second training session 3 months after initial session for any follow-up or additional training requested by owner's personnel. Allow 3 hours for the second training session.

1.9 OPERATOR WORKSTATION (OWS)

A. The Operator Workstation shall be any personal computer, connected to the LAN, with appropriate web browser software installed.

1.10 ENGINEERING WORKSTATION (EWS)

A. The Engineering Workstation shall be any personal computer, connected to the LAN, with a registered copy of the EMCS contractor supplied engineering and/or programming software installed. The EMCS contractor shall provide at least one copy of all required software(s), to enable the Owner complete editing/programming functions of all controllers, graphics, and control logic.

B. The EMCS shall provide one personal computer (PC) which is compatible with the performance required by the EMCS Engineering Software if an engineering workstation is specified for the system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE EMCS VENDORS

A. ALERTON - Climatec

B. AUTOMATED LOGIC - Branch Office

C. JOHNSON CONTROLS - Branch Office

D. RELIABLE CONTROLS - Unify Energy Solutions - Enviromatic

E. DELTA - Team Solutions

2.2 PRIMARY NETWORK SERVER (PNS)

A. The EMCS Contractor shall provide and install the Primary Network Server as part of this system. The PNS shall utilize the Internet and provide efficient integration of standard open protocols. The PNS shall maintain comprehensive database management, alarm management and messaging services, and graphical user interface as follows:
   01 Support an unlimited number of users over the Internet/intranet with a standard web browser to access alarms, trend logs, graphics, schedules and configuration data. Access to the PNS shall be password protected utilizing authentication and encryption techniques. An audit trail of database changes indicating user, time stamp, and audit action shall be provided.
   02 Enterprise level information exchange using an SQL database and HTTP/HTML/XML text formats.
   03 Synchronize controller databases, database storage scheduling, control and energy management routines
   04 Alarm processing and routing which includes email, SMS text messages and paging.
   05 HTML based help system that includes comprehensive online system documentation.
   06 Support of multiple Network Area Controllers (NAC) connected to a Local Area Network.

B. Server Functions
   01 It shall be possible to access all Network Area Controllers (NAC) via a single connection to the server through the Ethernet LAN. In this configuration, each Network Area Controller can be accessed from a single user login.
   02 The PNS shall provide the following functions, at a minimum:
      a. The server shall provide complete access to distributed global data. The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
      b. The server shall include a master clock service for its subsystems and provide time synchronization for all NACs.
      c. The server shall provide scheduling for all NACs and their underlying field control devices.

d. The server shall provide demand limiting control that operates across all NACs. The network server shall be capable of multiple demand limiting programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

e. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to NACs. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.

f. The server shall provide central alarm management for all NACs supported by the server. Alarm management shall include: routing of alarms to a video display, a printer, an email and pager; view and acknowledge alarms; query alarm logs based on user-defined parameters

g. The server shall provide central management of logged data for all NACs supported by the server. Logged data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include: viewing and printing log data; exporting log data to other software applications; query log data based on user-defined parameters

03 The Primary Network Server shall be capable of supporting the following open system drivers;

a. BACnet/IP

b. Modbus TCP

C. Network Server Platform Requirements

01 Rack-Mounted Server Computer Hardware: DELL PowerEdge R220 or equal, Intel Xeon Gold 3.0 GHz or higher, 32GB RAM, 2 TB hard drive, video card, 22” color monitor, and Ethernet adapter 1Gbps or higher.

02 Operating system software shall be Microsoft Windows® 10 Professional or higher.

2.3 NETWORK AREA CONTROLLER (NAC)

A. Provide one or more Network Area Controllers (NAC) to meet the sequence of operations and the type and quantity of devices being integrated into the system. The NAC shall provide the interface between the local area network and the field controllers. The NAC shall provide global supervisory control functions over the associated controllers and shall be capable of executing application control programs to provide: calendar functions; scheduling; trending; alarm monitoring and routing; time synchronization; integration of controller data for each applicable protocol; network management functions for all network devices. The user may view real-time information via web-based data.

B. The Network Area Controller shall provide the following hardware features as a minimum: Ethernet Ports 100Mbps or higher, BACnet MS/TP ports, battery backup, DDR RAM memory, flash memory for long term data backup.

C. Provide an uninterruptible power source (UPS) per network controller to maintain operation for 1 hours.

D. The NAC shall be capable of operation over a temperature range of 32 to 122 °F and operation over a humidity range of 5 to 95% RH, non-condensing; storage temperatures of between 32 and 158 °F.

E. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

F. The NAC shall be capable of supporting the following open system drivers;
   01 BACnet/IP
   02 BACnet MS/TP
   03 Modbus TCP
   04 Modbus RTU

G. Event Alarm Notification and actions: The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers. Alarm conditions shall be routed to any defined user location whether connected to a local or wide-area network.
   01 Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to: alarm; return to normal; fault.
   02 Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc. Allow timed routing of alarms by class, object, group, or node.
   03 Provide alarm generation from binary object “runtime” and/or event counts for equipment maintenance (i.e. filter status, fan run status). Authorized users shall be able to reset runtime or event count values with appropriate password control.
   04 Control equipment and network failures shall be treated as alarms and annunciated.
   05 Alarms shall be annunciated in any of the following manners as defined by the user: screen message text; e-mail of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on: day of the week, time of day and recipient.
   06 Color-graphic shall have flashing alarm object(s). Printed message may be routed directly to a dedicated alarm printer.
   07 The following shall be recorded by the NAC for each alarm (at a minimum): time and date; location (building, floor, zone, office number, etc.); associated equipment. Upon acknowledgement of the alarm the NAC shall document the time, date and authorized user. The number of alarm occurrences since the last acknowledgement shall be recorded.
   08 Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user. Alarm actions may be initiated by user defined programmable objects created for that purpose.
   09 Alarm archiving: A log of all alarms shall be maintained by the NAC and/or a server and shall be available for review by the user. Provide a “query” feature to allow review of specific alarms by user defined parameters. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

H. Data Collection and Storage: The NAC shall have the ability to collect data for any property of any object and store this data for future use.
   01 The user shall designate the log as an interval log or deviation log. For an interval log, the object shall be configured for time of day, day of week and the sample collection interval. For deviation log, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
   02 All log data shall be stored in a relational database in the NAC and the data shall be accessed from the server or a standard web browser. All log data, when accessed from the server, shall be capable of being manipulated using standard SQL statements.
   03 All log data shall be available to the user in the following data formats: HTML, XML, plain text, comma separated values, as a minimum.

04 The NAC shall have the ability to archive its log data either locally or remotely to the server or other NAC on the network.

I. Local Access: The NAC shall provide redundancy of system access to the local controllers at the remote building if the Primary Network Server should lose communication or be off-line. The NAC shall maintain setpoint and scheduling features, access to the color-graphic displays, maintain trend logs and reports. Upon restoration of communication with the PNS the archived information shall be transmitted to the server for archiving.

2.4 SOFTWARE FOR THE NAC

A. The distributed architecture of the operating system for the PNS and NACs shall provide the operator a comprehensive interface to allow the operator to configure and customize the EMCS to optimize the HVAC system to save energy, schedule and maintain equipment and provide occupant comfort. The provided graphical toolset shall allow the operator to create applications in a drag and drop environment.

01 Input/output capability shall allow the operator to request the current value or status of the control point; command/override equipment to a specific state; add, change or delete control points, alarm limits and controllers; change descriptors to control points and equipment; modify parameters; create or modify DDC loops.

B. Operator System Access: Via software password with five access levels at workstations and at each control unit.

C. Color graphic tools shall allow the user to create equipment and floor plan graphics from a standard library of symbols; allow custom generation of symbols; utilize over 64 or more colors; create real-time dynamic data for the graphics. Up to 60 control points may be displayed on each graphic.

01 Provide a link between compatible graphics to minimize the paths to additional information. For example, provide the link from the zone sensor to the VAV terminal to the air handling unit and to the central plant. Web pages shall be provided to allow the operator to zoom into specific areas of the facility and then link the space to the floor plan to the overall building and then to the facility site plan.

02 Graphical tools shall allow the creation of bar graphs, pie graphs and other tools to visualize control information such as run time hours, energy consumed and occupant comfort.

D. Alarm processing tools shall allow the operator to create alarm messages that include as a minimum: time of alarm, point descriptor, alarm condition and remote annunciation. Critical alarms shall be displayed, archived to a storage device or printed on a alarm printer. Alarms shall be displayed in order of occurrence and have an optional audible alarm indicator.

01 Print alarm messages, up to 60 characters in length, for each alarm point specified.

02 Alarms may be routed to other devices including web-enabled cell phones, pagers, tablet PCs and designated personal computers on the network or Internet.

03 Operator specifies when alarm requires acknowledgment. Continue to indicate unacknowledged alarms after return to normal. An alarm log shall be maintained to archive alarms for future reference with the above specified parameters as well as indicating the person acknowledging the alarm.

04 The graphical display shall indicate the number of the current unacknowledged alarms by individual building site or by sum of all campus-wide facilities.

05 The operator may create and forward an e-mail message to another user directly from the graphical interface so that the message can be read when the second user logs on to the system.

E. Upon a power failure to equipment in the facility, the EMCS shall automatically start equipment upon the restoration of power. Program a time delay between individual equipment restart on a schedule to minimize demand charges from the utility company.

F. Custom reports may be created by the operator with a requested time and date manually or automatically. All reports may be logged to a storage device for future reference. The data reports shall allow customization and scaling of the X-Y coordinates; plotting of tabular reports; provide multi-point graphical reports with not less than eight variables on the same report. Print reports on daily, weekly, monthly, yearly or scheduled basis as scheduled.

G. The network server current operating system, database, color-graphics, custom reports shall be backed up automatically to a remote server or storage device as directed by the owner's representative.

H. Maintenance Management capability shall allow the system to monitor and log the run-time for HVAC equipment; schedule maintenance reports that include recommended material and labor for the assigned task.

2.5 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. All devices required for single loop control shall be terminated on a single controller. (for example, CHW loop pressure control. The differential pressure sensor and the pump VFD ramp signal.)

B. ASCs shall be capable of implementing control strategies for the system based on information from any or all connected inputs. The AC shall utilize factory pre-programmed global strategies that may be modified by field personnel on-site. Global control algorithms and automated control functions should execute via a 32-bit processor

C. Programming shall be object-oriented using control program blocks that will support a minimum of 500 Analog Values and 500 Binary Values. Analog and binary values shall support standard BACnet priority arrays. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing.

D. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1 year (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. The onboard, battery-backed real time clock must support schedule operations and trend logs.

E. The base unit of the ASC shall host various I/O combinations including universal inputs, binary outputs, and switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.

F. All binary outputs shall have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. The position of each HOA switch shall be available system wide as a BACnet object.

G. Controller shall be capable of BACnet communication. BACnet Conformance:
   01 Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.

H. Schedules: Each ASC shall support a minimum of 10 BACnet schedule objects.

I. Logging Capabilities: Each controller shall support a minimum of 100 trend logs. Sample time interval shall be adjustable at the operator's workstation. Controller shall periodically upload trended data to system server for long term archiving if desired. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

J. Alarm Generation: Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures. Alarm logs shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects -system destination and actions individually configurable.

2.6 UNITARY SYSTEM CONTROLLERS (USC)

A. All devices required for single loop control shall be terminated on a single controller. (for example, cooling coil control valve control. The temperature sensor and the valve control signal.)

B. The EMCS Contractor shall provide all Unitary System Controllers. USCs shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in Flash RAM.

C. The USC shall be a node on the automation network and shall control its own communications so that the failure of any one node, shall not inhibit communications on the network between the remaining nodes. USCs shall be totally independent of other network nodes for their monitoring and control functions.

D. Provide each USC with a battery back-up for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a seven-year life.

E. All associated applications programs shall reside at the USC. The USC shall not require communication to any other panel for normal operating sequences other than time scheduled base commands.

F. Control shall be based on algorithms, i.e. proportional plus integral plus derivative (PID), proportional plus integral (PI), or proportional to comply with the sequences of operation PID algorithms shall maintain the system operation within +/- 2% of setpoint.

G. The USC shall be configured with sufficient input/output capacity to achieve the required control points to meet the sequence of operations.

2.7 AIR HANDLING UNIT CONTROLLER

A. All devices required for single loop control shall be terminated on a single controller. (for example, AHU static pressure control. The differential pressure sensor and the VFD ramp signal.)

B. The EMCS Contractor shall provide controllers required for chilled/hot water and DX/electric heat air handling units and fan coil units. Provide an enclosure to house the controller and associated components including suitable mounting brackets shall be NEMA 1 rated and located outside the FCUs.

C. The controller shall be capable of monitoring and controlling the following parameters per the sequences of operation and input/output summary; space temperature; space relative humidity sensor; cooling/heating stage control or modulating valve control; fan on/off control and status; supply air sensor; occupancy sensor; carbon dioxide sensor; VFD control and monitoring.

2.8 EMCS CONTROLLER LEVEL NETWORK

A. EMCS Automation Level Network shall consist of BACnet MS/TP (76.8 Kbps minimum). Data transfer rate and data throughput as required to meet the alarm annunciation requirements.

2.9 SOFTWARE OVERVIEW

A. Dynamic Colored Floor plans: Dynamic colored floor plans that compare actual space conditions to setpoints shall be provided on all floorplan graphics displayed on the front-end. Floorplan enlargements shall also use the thermographs to display space conditions. Zones within the set point range shall appear transparent white. As the space gets warmer the zone color shall gradually modulate from transparent white to transparent red to identify a hot zone. As the space conditions get cooler the zone color shall gradually modulate from transparent white to transparent blue to identify a cold zone. Each zone shall indicate the current actual zone temperature within the zone. The floor plans shall use a dynamic scheduling icon to indicate schedule occupancy for each zone and provide direct one-click access to that zones unique schedule. Provide a designated icon or symbol indicating that the zone is in the occupied/unoccupied condition. From the floorplan graphic, the operator shall be able to click on any zone and go directly to the graphic for the piece of equipment controlling that zone. All dynamic floor plans shall be visible via web interface as well as on the LAN. The authorized system operator shall be able to change the zone or system identifier (or name) on the graphic and that change shall be distributed to other associated graphics and to the equipment controller.

B. Pop up Trends: Provide trend logs that automatically pop up when the operator mouse clicks on the point from the graphic. Provide pop up trends for all dampers, control valves, temperature sensors, carbon dioxide sensors, humidity sensors, airflows, static pressures, flow meters, VFD speeds, etc. The EMCS contractor shall set up all trends for the owner. The pop-up trend shall include a trend tool that allows the operator to modify the trend time scale and sample interval for up to 10 sample values. The trends shall be graphical on the computer screen but shall provide an output as an .xls, .csv, .pdf, HTML, or text file.

C. Interactive Maps: Implement JAVA SCRIPT API 3.0 or newer, such as Google Interactive maps depicting the facility location to indicate the site plan. This is not a static image and must be completely interactive.

D. Custom User HTML applications: The EMCS shall utilize HTML applications as an extra feature. At minimum, provide 7-day forecast, weather radar, traffic map and hurricane tracker. All of these features shall be imbedded into the EMCS system.

E. Provided a web-based EMCS platform; contractor shall provide an Open License software. Licenses that are not open are not acceptable. There shall be no per seat or per user licensing fee charged to the owner by the contractor.

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 shall be BACnet Objects.

G. User access shall include 50 assigned operators that shall include five levels of access within the web system. Each operator log-in shall have an expiration date to allow for temporary access to the system. The operator's access description shall include his e-mail address and cell/phone numbers. The operator access can be limited from 5 minutes to permanent access. The user shall be limited to eight bad login attempts before being locked out of the system.

H. Global modification: Provide the capability for global modification of user definable parameters of all points shall be provided. Global modification is defined as the mass adjustment of user definable parameters across a defined group, area, facility, campus, or network. Parameters shall include, but not be limited to temperature set point (VAV boxes, AHU Discharge, VAV AHU Static Pressure Setpoints etc.), equipment start/stop, equipment status, valve output signal, VFD speed control signal, and damper position signal. User shall be able to lock the definable parameter to a set value, or adjust a set point to an operator adjustable value. This function shall be accomplished through the standard graphical user interface/workstation and is to be selectively applicable by the user to all controllers on the network, all controllers in a specific facility or all controllers in a specific zone within a specific facility.

I. The system operator shall be able to override the output signal to the valves, dampers, variable frequency drives, etc. with the use of the PC mouse click on the device. The system override shall include a Hand-Off-Auto (HOA) capability. If the output is commanded to the hand position the operator shall designate an output value of 0-100% in 1% increments. The hand override position shall be permanent or expire after a designated time period and revert to the auto position. The color-graphic shall indicate the device that has been overridden by a color change of the output value.

J. For non-emergency in-warranty events the system operator may submit a Service Request directly from the floor plan or system graphic. The web interface shall include the EMCS suppliers contact information including phone numbers and e-mail address. The service request will be logged into the EMCS suppliers service department. A non-response by the assigned technician shall elevate the request to the next highest manager or supervisor until the system operator receives an response that their request has been received and is scheduled for a resolution. All requests for service shall be maintained in the customer's database for future reference. The service request capability may be extended after the expiration of the warranty as part of a service agreement.

K. The web-based system shall be accessible from Tablet PCs and provide the same functionality that is available from personal computers connected through the LAN or WAN to the system operator. The tablet PCs as a minimum shall include an Apple iPad and Google Android based tablet PC. Operation shall include touch screen capability and use of the tablet keyboard screen. The operator shall be able to view color-graphics, system trends, override setpoints, change time schedules, and override damper and valve positions.

2.10 ENERGY SAVING PROGRAMS

A. Demand Limiting: Demand limiting programming and sequence shall include, but not be limited to the following:
   01 Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
   02 Integrate with lighting controls to reduce lighting power to an operator set maximum demand level.
   03 Provide a means from the graphical user interface for the system operator to manually initiate or disable the demand limiting sequence.

04 Provide programming that will allow a demand response signal from an approved entity (electrical service provider) to remotely initiate or disable the demand limiting sequence.

05 Provide programming that will initiate demand limiting according to a schedule.

06 When demand limiting is initiated, the EMCS shall:

a. Increase the space cooling temperature setpoint by 4 degrees F (adj), above the current operating setpoint. The rate of change for the temperature setpoint increase shall be operator adjustable.

b. Decrease the space heating temperature setpoint by 4 degrees F (adj), below the current operating setpoint. The rate of change for the temperature setpoint decrease shall be operator adjustable.

c. Automatically reduce lighting power on the circuits indicated on construction documents.

07 When demand limiting is disabled, the EMCS shall reset temperature setpoints and lighting power levels back to original operating setpoints.

08 Demand limiting shall be confined to “non-critical” zones. For purposes of planning, assume all zones are “non-critical” unless otherwise noted on the construction documents. All zones shall have the option to be added or removed from the demand limiting program, by the system operator.

09 The EMCS shall include a graphic "page" that shows all adjusted setpoints (original setpoints and demand limited setpoints) and the power meters being monitored to confirm the programming is operational and effective at shedding the associated loads.

B. Duty Cycling: Periodically stop and start loads, based on space temperature, and according to various on/off patterns.

C. Automatic Time Scheduling: Self-contained programs for automatic start/stop/scheduling of building loads. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary schedules.

D. Optimal Start/Stop: Perform optimized start/stop as function of outside conditions, inside conditions, or both. Optimization shall be adaptive and self-tuning, adjusting to changing conditions by modifying occupancy period based upon the desired temperature at beginning and end of the occupancy period. Base optimization on occupancy schedules, outside air temperature, seasonal requirements, and interior room temperature. Employ adaptive model prediction for how long building takes to warm up or cool down under different conditions.

E. Night-Setback Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours in conjunction with scheduled start/stop and optimum start/stop programs.

F. Setpoint Reset: Setpoints for control of variable load systems shall be reset based on load demand, as described in the Sequence of Operations.

G. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

H. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.

I. Holiday Scheduling

J. Direct Digital Control: Furnish software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.

K. Trend logging shall be provided for all points per the input/output summary where there is a change in the analog or binary signal. Each controller shall be capable of storing trend values and then automatically transfer data to the NAC or the NS hard disk. Trend data shall be updated continuously per the operator assigned interval at intervals as low as one minute. Collect samples at intervals specified in minutes, hours, days, or month. Output trend logs as line-graphs or bar graphs. Binary points (input and output) shall only be logged upon a change of value (COV). Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.11 FIELD INSTRUMENTATION

A. Temperature Sensors: All temperature sensors shall be thermistor type, factory-calibrated to within 0.5 °F, interchangeable with housing appropriate for application. Sensors shall have a temperature curve rated for the application. Sensor wiring terminations shall be in a galvanized box.
   01 Outside air temperature sensors shall be installed in weather proof enclosure with ventilated sun-shied.
   02 Duct mounted temperature sensors shall be averaging type for supply air, mixed air and low temperature applications for air handling units. Duct probe temperature sensor shall be acceptable for terminal units.
   03 Space temperature sensors shall contain a backlit LCD digital display and user function keys along with temperature sensor, setpoint adjustment and after-hours override use. Override time may be set in one-hour increments.
   04 Thermowell temperature sensors shall be stainless steel probe of length that is equivalent to a minimum of 50% of the pipe diameter. End-to-end accuracy shall be ± 0.5 deg. F. Connection box shall be moisture/water proof with conduit fitting. Furnish the stainless steel thermowell to the mechanical contractor for installation. A thermal conducting grease shall be installed in the thermowell to provide uniform temperature sensing.
   05 Provide flat plate stainless steel space temperature sensors with no local setpoint adjustment as indicated on the drawings.

B. Relative Humidity Sensors: relative humidity sensors shall be a two-wire type, 4-20 mA output proportional to the relative humidity range of 0-100%. The accuracy of the sensors shall be +/- 2% over a range of 10-90% RH.
   01 Outdoor relative humidity sensors: provide non-corroding outdoor shield to minimize wind effects and solar heating. Install wall-mount weather proof enclosure with conduit fitting. Sensor shall be Veris HO series, or equivalent.
   02 Wall-mounted relative humidity sensor: sensor shall be installed in a wall-mounted enclosure with white cover. Sensor shall be Veris HEW series or equivalent.
   03 Duct-mounted relative humidity sensor: sensor shall be provided with a moisture resistant enclosure with conduit fitting. The probe length shall be 8” minimum. Sensor shall be Veris HED series or equivalent.

C. Pressure Transducers:
   01 Air pressure transducer: The pressure transducer shall have an input range compatible with the medium being measured. The proportional output signal shall be 0-10 VDC or 4-20 mA. The accuracy shall be +/- 0.25% FS. Transducer shall be SETRA Model 264 or equivalent. Air pressure sensors and all associated tubing, hardware, and accessories shall be provided as appropriate for the application.

a. Duct mounted pressure sensor shall be stainless steel and provided with mounting flange and hardware. The sensor probe length shall be appropriate for the associated duct dimensions.
b. Wall mounted space pressure sensor shall include stainless steel wall plate, pressure pick up filter, and mounting hardware.
c. Ceiling mounted space pressure sensor shall be paintable, low-profile type, with pressure pick up filter, integral surge dampener, and adhesive ring for ceiling mount.
d. Outdoor pressure sensor shall include an outdoor rated sensor, 50 ft. of vinyl tubing, mounting bracket and hardware. A surge dampener shall also be provided for all outdoor pressure sensor applications to absorb pressure fluctuations.

02 Water pressure transducer: The pressure transducers shall have an input range compatible with the medium being measured. The proportional output signal shall be 0-10 VDC or 4-20 mA. The accuracy shall be +/- 0.25% FS. Transducer shall be SETRA Model 230 or equivalent. Transducer shall include a valved piping bypass and bleed off for each port. Water pressure sensors and all associated tubing, hardware, and accessories shall be provided as appropriate for the application.

D. Freezestat: Provide freezestats for all chilled water air handling systems that receive more than 10% untreated outside air. Freezestats shall provide vapor tension elements, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide one linear foot per square foot of coil surface area. Freezestat shall be manually reset at the switch. Interlock to the associated fan so that fan will shut down when HOA switch is in hand or auto position. Provide time delay relays with a 0-10 minute time delay relay duration to minimize nuisance freezestat trips. Time delay relay shall be adjustable at the associated control panel.

E. Air differential pressure switch: For fan shutdown, provide air differential pressure switches for all fans controlled by a variable frequency drive (VFD) to shut down the associated fan in the event of sensing high differential pressure. Air differential pressure switches shall have an adjustable setpoint with a range of 0-10 inches w.g. with manual reset at the switch unless otherwise indicated to be automatic reset or required by the application to be automatic reset. Provide ¼ inch copper tubing with compression fittings to mount to the side of the duct. Sensor shall be DWYER Series 1900 or equivalent.

F. Momentary control relays: Provide momentary control relays as indicated. Relays shall have coil ratings of 120 VAC, 50 mA or 10-30 VAC/VDC, 40 mA as suitable for the application. Contact ratings shall be 10 amp. Provide complete isolation between the control circuit and the digital output. Relays shall be located in the UC or other local enclosures and have pin-type terminals. Relays shall have LED indication of status.

G. Current sensing relay: Current sensing relays shall be rated for the applicable load. The output relay shall have an accessible trip adjustment over its complete operating range. Enclosure shall have an LED to indicate relay status.

H. Photocell: Ambient light level shall by a photocell in a non-corroding in a weatherproof housing with sun shield suitable for exterior installation. The control signal output shall be 4-20 ma or binary contact closure as specified in the sequences of operation. Mount the photocell on the north side of the building on the roof. The sensor reading shall be 0-750 foot-candles.

I. Occupancy Sensors

01 Occupancy sensors shall be dual-technology, ceiling mounted type. Sensors shall be capable of detecting presence in the control area by via Doppler shifts in transmitted ultrasound and passive infrared (PIR) heat changes. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off. The sensor shall operate at 24 VDC/VAC. WattStopper DT-300 or approved equal.

02 Sensors shall have a time delay that is adjustable with configuration software or shall have a fixed time delay of 5 to 30 minutes, set by a DIP switch. Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.

03 The sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options. The sensor shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled.

2.12 DAMPERS

A. Provide motorized volume control and shutoff dampers as detailed in 23 33 00 - Ductwork Accessories.

2.13 DAMPER ACTUATORS

A. Outside and exhaust air damper actuators shall be mechanical spring return. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.

B. Outside and return air modulating actuators shall utilize analog (proportional) control 0-10 VDC. Actuators shall be driven in both the open and closed directions.

C. Electric damper actuators shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.

D. Single section dampers shall have one electronic actuator direct shaft mounted.

E. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section.

F. Damper actuators shall be BELIMO or equivalent.

2.14 PANELS AND ENCLOSURES

A. Provide panels and enclosures for all components of the EMCS, which are susceptible to physical or environmental damage.

B. Interior panels and enclosures shall meet be NEMA 1 rated painted steel panels with locking door.

C. Exterior mounted panels and enclosures shall be NEMA 4 painted steel panels with locking door.

D. Panels for USCs shall be mounted on the outside of all unit ventilators and fan coil units with three feet of wall clearance in front of them and no higher than 7 feet to the bottom of the panel.

2.15 LABELING AND WARNING NOTICES

A. Provide labeling for all control panels and enclosures.

B. Provide labeling of all control wires and input/output points at the controller and at the control device; the label at each end of the wire shall be the same Labels shall be machine generated, typed and clearly legible with a maximum of 17 characters. Hand written labels or labels written on the control wire jacket will not be acceptable. Each label shall be unique to its function and shall reference the applicable system. For example “AHU-1 SAT” will indicate the supply air temperature sensor for AHU-1. Improper labeling shall be removed and shall require re-commissioning of the control device and controller to document correct functionality.

C. Provide high voltage warning notices at all equipment controlled by the EMCS and at all associated motor starters when used by equipment controller.

2.16 TUBING AND PIPING

A. Provide tubing and piping as required for the field instrumentation.

B. Tubing within equipment rooms, vertical risers, and penetrations to ductwork shall be either copper pipe or shall be plastic tubing within conduit. Tubing for all water-based instrumentation shall be copper pipe. Identify the type of tubing proposed in the shop drawing submittal.

C. Provide suitable bulk head fittings for duct and panel penetrations.

D. Tubing in plenum rated areas may be plastic tubing. Polyethylene tubing shall meet, at minimum, the following requirements: flame retardant; crack resistant; 300 psi burst pressure.

2.17 CONDUIT AND FITTINGS

A. Provide all conduits, raceways and fittings for the EMCS monitoring, communication and control cabling. All work shall meet all applicable codes.

B. Conduit, where required, shall meet, the requirements specified within Division 26.

C. EMCS monitoring and control cable shall not share conduit with cable carrying voltages in excess of 90 VAC.

2.18 CABLING

A. Provide all cables for the EMCS. Cable shall meet, at minimum, the following requirements:
   01 Minimum 98% conductivity stranded copper.
   02 Proper impedance for the application as recommended by the EMCS component manufacturer.
   03 Monitoring and control cable shall be #18 AWG or larger, dependent on the application. Analog input and output cabling shall be shielded.
   04 Management Level Network cable shall be CAT 6, 24 gauge unshielded.
   05 Automation Level Network cable shall be #24 AWG shielded.

06 Shield shall be grounded at the CCP, UC, or control panel. Ground at one end only to avoid ground loops.

07 Identification of each end at the termination point. Identification should be indicated on and correspond to the record drawings.

B. 120 VAC power wiring shall be of #12 AWG solid conductor or larger as required.

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION

A. The EMCS supplier shall provide a pre-construction coordination meeting with the affected trades to ensure a cooperative efficient process of installation. The invited trades shall include the general contractor, mechanical contractor, electrical contractor, test and balance contractor, commissioning provider, owner's representative, consulting engineer and others with a direct interest in the coordination of the affected systems. The EMCS contractor shall provide an outline of the meeting agenda highlighting the construction schedule, coordination with mechanical and electrical trades. Provide a sign-in sheet and submit it through the attendees along with a summary of the meeting notes for future reference.

3.2 INSPECTION DURING INSTALLATION

A. Provide a technician to assist the Engineer or Owner's Representative with inspections made during the installation period that are required to review the progress and quality of ongoing work. The engineer/owner's representative shall generate field observation reports on the findings of the inspection. The engineer or owner's representative shall advise the EMCS contractor during the inspection of any concerns noted with respect to the installation and shall repeat the concerns in writing as soon as possible after the inspection is completed. The EMCS contractor shall take corrective action to meet the requirements of the specifications. Upon correction, the EMCS contractor shall submit written documentation through the contractors to the engineer.

3.3 INSTALLATION OF COMPONENTS

A. Provide all interlock and control wiring. All wiring shall be installed in a neat and professional manner in accordance with specification Division 26 and all national, state and local electrical codes.

B. All wiring shall be installed as continuous lengths with no splices permitted between termination points.

C. Provide wire and wiring techniques recommended by equipment manufacturers. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the Owner's Representative prior to rough-in. Provide auxiliary pilot duty relays on motor starters as required for control function.

D. Maximum pulling, tension, and bend radius for wiring and cable installation, as specified by the manufacturer, shall not be exceeded during installation.

E. Electrical Contractor shall provide 120 or 277 volt power at a junction box within 48" of the controller. The BAS Contractor shall coordinate with the Electrical Contractor to identify locations of power requirements prior to the installation of the controls.

F. Conduit for control wiring shall be provided whenever one of the following conditions exists:
   01 Conduit is indicated on the drawings or specifically required by the specifications.
   02 Cabling runs through inaccessible areas such as within partitions/walls, above closed in ceilings, under floor; within trenches and underground; on the exterior of the building; exposed on the surface of the building; when encased in concrete or other material that makes the cable inaccessible or when located such that access to the cable is not readily obtained.
   03 Cable within mechanical, telecommunications and electrical equipment rooms and control rooms.
   04 Conduit shall be installed, inside wall from sensor box to above the wall, for all wall mounted temperature, humidity and CO2 sensors.

G. Size of conduit shall be in accordance with the manufacturer's recommendations, specifications of Division 26, and NEC requirements.

H. Secure conduit with conduit clamps fastened to the structure and spaced according to Division 26 and code requirements. Conduit shall not be hung on flexible duct straps or tie rods. Conduit shall not be run on or attached to ductwork.

I. Control wiring located above accessible ceilings may be plenum rated cable. Plenum rated cable shall be neatly bundled and routed parallel or perpendicular to building surfaces.

J. Where plenum rated cable is installed without conduit, it shall be supported from or secured to the building structure. Cables shall be supported independently by cable hooks and shall not be supported by or secured to ductwork, electrical conduits, piping, or ceiling suspension systems. Multiple cables are to be dressed every 5 ft. to 7 ft. Cables shall be supported at a maximum of 10 ft. intervals with a maximum cable sag of 6" between supports.

K. Control wiring located in underground conduits shall be provided with direct-burial-rated insulation.

L. When communication bus enters or exits a building, a surge suppressor shall be installed. The surge suppressor shall be installed according to the controls manufacturer's instructions.

M. Provide sleeves for all cable and conduit passing through walls, partitions, structural components, floors and roof. Maintain fire rating at all penetrations through fire rated construction.

N. All communication wiring shall be labeled to indicate origination and destination data.

O. All sensor wiring shall be labeled to indicate the origination (at the device) and destination of data (at the control panel). The description shall indicate the type and location of the control device such as "AHU-1 SA temp" or "VAV 1-1 space temp".

P. Wall temp sensors at 48" above the finished floor to comply with ADA requirements and to match the height of the light switches. Mount humidity sensor at equal height to wall temperature sensor.

Q. Outdoor pressure sensors shall be installed a minimum of five feet above the roof surface and shall be free of immediate obstructions and sources of turbulence that could affect pressure readings. Sensors shall be attached to the top of roof mounted equipment or provided with stand-alone vertical support if no roof mounted equipment is available. Sensor tubing shall be routed into the building through a sealed weathertight penetration. Provide a heat trap loop in the sensor tubing immediately below the roof.

3.4 VERIFICATION REQUIREMENTS

A. Verification shall be provided by the EMCS contractor to demonstrate and confirm that the installed system complies with the specifications and the control sequences of operation herein specified. upon completion of the verification process the EMCS contractor shall demonstrate to the engineer or owner's representative the functionality of the control system devices are in compliance with the contract documents.

B. Technicians provided by the EMCS contractor shall be factory trained and qualified in the operation of the provided control system. The EMCS contractor shall provide, if requested, the factory training certificates of the individuals providing the verification services on this project.

C. Verification tools, applicable to the system provided, shall be utilized by the factory-trained technicians for proper verification of system operation and functionality. Temperature verification sensors shall be NIST certified within the last 12 months. Meters such as Fluke 52 series or better shall be utilized. Use of non-certified meters may require the system to be re-verified with certified meters at no cost to the owner.

D. Documentation of the verification process shall be provided per the project general conditions in electronic PDF format as required. Documentation shall include the following forms:
   01 Project System Verification Forms for each controller provided on the project to verify the proper function of each controller, control device and system component provided.
   02 Panel Verification Forms for each control panel to document the proper installation and function of each control panel provided.
   03 Sequence of Operation Verification Forms for each piece of controlled equipment to confirm compliance of the control system with the specified sequences of operation.
   04 Not providing proper documentation for each control devices, panel, or system, upon request by the engineer or owner's representative, may require the EMCS contractor to re-verify the applicable systems at no additional cost to the owner.

E. After completion of the verification, the EMCS contractor shall be able to demonstrate the sequence of operations for each system to the engineer and the owner's representative.

F. Equipment checkout sheets are to be produced by this contractor showing checkboxes and compliance with the following procedures for each piece of equipment and turned over to the owner and/or mechanical engineer.

3.5 COLORGRAPHICS

A. The colorgraphics shall be provided for the EMCS system prior to system acceptance and owner training.

B. The colorgraphics provided shall include the following as a template. Provide forward and backward links on the graphic.

01 Site plan with link to overall building plan including detached buildings. The site plan shall be referenced to an automatically updated aerial view or map view of the area such as Google Maps or Bing Maps. Provide link to proceed to the overall building floor plan.

02 The overall building plan shall indicate space temperature conditions referenced by the color of the zone. Specific details of the zone temperatures and equipment are not required. Provide a link to the floor plan wings, upper floors and remote buildings.

03 The floor plan colorgraphics shall indicate the space temperatures by color references. Additional information shall indicate the space temperature, the occupancy of the zone, air handling units, VAV terminals and ductwork with diffusers. A link at each terminal unit or AHU shall automatically connect the system operator to the equipment colorgraphic.

04 The colorgraphics for the equipment shall as a minimum be equal to the points from the input/output summary or control schematic. Primary control devices as required by the sequences of operation shall also be provided.

05 Control points from equipment that are integrated into the EMCS via BACnet shall be provided to convey the operating conditions of the attached equipment. Coordination of the integration points shall be accomplished during the submittal phase. The EMCS contractor shall provide a list of all integrated points on their submittal.

3.6 ENERGY MONITORING PROGRAMMING AND GRAPHICS

A. The EMCS shall be programmed to include a dedicated graphics page for energy monitoring.

B. The kW and kWH data acquired from each power meter shall be categorized within the EMCS by the following end-uses.

01 Total HVAC system loads
02 Interior lighting loads
03 Exterior lighting loads
04 Plug loads
05 Process loads
06 Building operations and other miscellaneous loads

C. The EMCS shall provide a graphic representation to show instantaneous real-time energy consumption data and shall provide hourly, daily, monthly, and yearly energy consumption data. Where multiple meters are used to measure an end-use category, the graphic representation for that end-use category shall include data from the individual meters as well as a total for the associated category. The graphic representation shall also include time and date of the highest peak demand for the current month and year as well as prior months and years for stored data. Demand thresholds may be set to adjust and shed loads in order to reduce peak consumption.

D. All meter data collected shall be stored for a minimum of 36 months and shall have the ability to be trended by building operation and management personnel on an hourly, daily, monthly, and yearly basis using the previous 36 months of stored data.

3.7 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Startup testing documentation: Prepare the checklist documenting startup testing of each input and output device, with technician's initials and date certifying each device has been tested and calibrated prior to acceptance testing. This document shall indicate proof that the following functions have been commissioned and shall be included in the as-built documentation: short to ground check, configuration of trends, confirmation that color-graphics are accurately representing actual systems, point to point checkout, all damper and valve actuators respond to input change, control modules are addressed and have functional descriptors, specified interlocks are functional, calibration report of all sensors, discrete outputs respond to time schedule or manual enable command.

B. Demonstration. Prior to acceptance, demonstrate the following performance tests to demonstrate system operation and compliance with specifications.

01 Engineer, owner’s representative and mechanical contractor shall be invited to observe and review system demonstration. Provide attendees at least 10 days notice.

02 Demonstration shall follow process approved as part of the submittal and shall include complete checklists and forms for each system as part of system demonstration.

03 Demonstrate actual field operation of each sequence of operation as specified. Demonstrate calibration and response of any input and output points requested by engineer or owner’s representative.

04 Demonstrate complete operation of operator interface including review of color-graphics, time schedules, trend logs, alarm notification, functionality of tablet PC operation.

a. PID loop response. Supply graphical trend data output showing each PID loop's response to a set point change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be selectable from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show set point, actuator position, and controlled variable values.

b. 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 set points and other affected equipment parameters.

c. Trend logs for each system. Trend data shall indicate set points, operating points, valve positions, and other data as specified. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs.

05 Alarms and Interlocks. Check each alarm with an appropriate signal at a value that will trip the alarm. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction. Alarm verification shall include temperatures exceeding alarm threshold (high and low), fan failure safety, duct high static pressure switch, freezestat, and smoke detector shutdown.

06 Tests that fail to demonstrate proper system operation to the engineer shall be repeated after contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

C. Owner Acceptance.

01 After tests described in this specification are performed to the satisfaction of both engineer and owner’s representative, the engineer shall accept the control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond EMCS contractor's control. Engineer shall provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

02 System shall not be accepted until completed demonstration forms and checklists are submitted and approved by the engineer.

3.8 DEMONSTRATION AND OWNER TRAINING

A. Furnish basic operator training for multiple persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 16 hours: 8 hours instructor time for onsite training and 8 hours of hands on class environment training. Training sessions may be provided in 4-hour increments as approved by the owner’s representative.

01 Change/modify temperature setpoints.

02 Change/modify time of day, holiday and override schedules.

03 Display, create, and modify trends of system points.

04 Update room numbers on the color-graphics.

B. Demonstrate complete and operating system to Owner. Provide written documentation listing the attendees of the specified training with sign-in sheet and training time and date.

3.9 SEQUENCE OF OPERATIONS

A. Refer to the Mechanical Drawings for project control schematics and sequence of operations.

END OF SECTION

SECTION 23 21 13

ABOVE GROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Pipe and pipe fittings.

B. Flanges, unions, dielectric connections, and couplings.

C. Valves.

D. Condensate drain piping.

1.3 RELATED WORK

A. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 23 05 53 - Identification for HVAC Piping and Equipment

E. Section 23 07 19 - HVAC Piping Insulation

1.4 REFERENCES

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.

D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.

E. ASME B31.1 - Power Piping; 2024.

F. ASME B31.3 - Process Piping; 2024.

G. ASME B31.9 - Building Services Piping; 2020.

H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

I. ASSE 1079 - Performance Requirements for Dielectric Pipe Unions; 2012.

J. ASTM B32 - Standard Specification for Solder Metal; 2020.

K. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.

L. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.

M. ASTM D1384 - Standard Test Method for Corrosion Test for Engine Coolants in Glassware; 2005.

N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

O. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

P. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

Q. ANSI/AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

R. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

S. ASTM B32 - Solder Metal.

1.5 QUALITY ASSURANCE

A. Foreign made pipes and fittings will not be acceptable.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.

D. Welder’s Certification: In accordance with ASME BPVC-IX.

1.6 SUBMITTALS

A. Submit product data under provisions of Division One.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

C. Include welder’s certification of compliance with ASME BPVC-IX.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division One.

B. Store and protect products under provisions of Division One.

C. Deliver and store valves in shipping containers with labeling in place.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, proper storage and dunnage, completing sections of the work, and isolating parts of completed system. Tape will not be allowed as an acceptable end cover.

PART 2 - PRODUCTS

2.1 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized.
   01 Fittings: Galvanized cast iron, or ASME B16.3 malleable iron.
   02 Joints: Threaded, or grooved mechanical couplings.

B. Copper Drainage Tubing: ASTM B306, DWV.
   01 Fittings: ASME B16.23 cast copper alloy solder joint DWV fittings or ASME B16.29 wrought copper alloy solder joint DWV fittings.
   02 Joints: Soldered joints made in accordance with ASTM B828 using ASTM B32 Alloy Grade Sn50/Pb50 solder.

2.2 FLANGES, UNIONS, DIELECTRIC CONNECTIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: Provide 150 psi malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: Provide 150 psi forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene bonded gasket.

C. Dielectric connections for pipe sizes 2 inches and under: Provide dielectric unions, rated at 180°F at 250 psi in compliance with ASSE 1079.

D. Dielectric connections for pipe sizes larger than 2 inches: Provide dielectric flanged pipe fittings, rated to 180°F at 175 psi in compliance with ASME B16.1.

E. Grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an option to welding, threading or flanged methods. All grooved components shall be of one manufacturer, and conform to local code approval and/or is listed by ASME B31.1, ASME B31.3, ASME B31.9, ASME, UL/ULC. FM, IAPMO or BOCA. Grooved end manufacturer to be ISO 9001 certified. Grooved couplings shall meet the requirements of ASTM F1476. Manufacturer shall be Victaulic, Anvil Gruvlok, or Shurjoint. Can be utilized only in mechanical rooms or cooling tower areas.

2.3 ACCEPTABLE MANUFACTURERS - VALVES

A. Milwaukee

B. Crane

C. Nibco

D. Apollo

E. Bray

F. Kitz

2.4 ACCEPTABLE MANUFACTURERS - VALVES (GROOVED ONLY)

A. Victaulic

B. Anvil Gruvlok

C. Shurjoint

2.5 BALL VALVES

A. Up to 2 Inches: Bronze two-piece body, 600 PSI full port, stainless steel ball and stem, teflon seats and stuffing box ring, lever handle, and balancing stops, threaded ends.

B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive hand wheel for sizes 10 inches (250 mm) and over, flanged.

C. Ball valves installed in insulated lines shall have stem extensions compatible with up to 2" of insulation. Extensions shall be non-metallic equal to Nibco "nib-seal".

2.6 PLUG COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends, with one wrench operator for every ten plug cocks.

B. Over 2 Inches: Cast iron body and plug, pressure lubricated, teflon packing, flanged ends, with wrench operator with set screw.

2.7 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

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.

D. After completion, fill, clean, and treat systems.

E. Provide extended necks for all vents, thermometer wells, pressure gauge wells, pet cocks and pete's plugs.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space and other work.

C. Group piping whenever practical at common elevations.

D. Branch tap connections to piping mains shall be from the top of the pipe.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

F. Provide clearance for installation of insulation, and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.

H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

J. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 09.

K. Install valves with stems upright or horizontal, not inverted.

L. All grooved components (couplings, fittings, valves, gaskets, and specialties) shall be of one manufacturer.

M. Grooved manufacturer shall provide on-site training for contractor's field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and the product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products.

3.3 APPLICATION

A. Use grooved mechanical couplings and fasteners only in mechanical rooms or cooling tower area.

B. Install unions downstream of valves, and at equipment or apparatus connections.

C. Provide non-conducting dielectric connections wherever joining dissimilar metals.

D. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

E. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Install plug valves for throttling, bypass, or manual flow control services.

G. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

H. Provide 3/4-inch ball (drain) valves equal to Nibco T-585-70-HC at main shut-off valves, low points of piping, bases of vertical risers, and at equipment and pipe to nearest drain.

I. Provide automatic air vents at all high points and air pockets in the system. Where automatic air vents are installed above a ceiling or in other concealed locations, provide vent tubing to nearest drain.

J. Provide manual air vents as indicated on details and drawings.

3.4 CONDENSATE DRAIN PIPING

A. Drain piping from each unit shall be extended to the nearest floor drain or condensate drainage system. Drains shall be of the size indicated but not less than the full size of the drain pan connections.

B. Use plugged tees in lieu of elbows.

C. Slope all drain lines 1/8" per foot, minimum.

D. Provide auxiliary drain pan on all AHU's above ceiling with auxiliary drain line routed to discharge in visually prominent area. Discharge location shall be coordinated with Architect.

3.5 PIPE FABRICATION AND INSTALLATION

A. All pipes shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing.

B. Piping layout and installation shall be made in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance from other work. Particular attention shall be given to piping in the vicinity of equipment; layout shall be made in such manner as to preserve maximum access to the various equipment parts for maintenance.

C. All changes in directions shall be made with fittings; field bending and mitering of pipe is prohibited.

D. Air vents and air chambers shall be installed as hereinafter specified.

3.6 OFFSETS AND FITTINGS

A. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, etc. which may be required. The Contractor shall carefully investigate structural and finish conditions affecting the Work, and shall take such steps as may be required to meet such conditions at no additional cost to the Owner.

B. All piping shall be installed close to walls, ceilings and columns, (consistent with the proper space for covering, removal of pipe and special clearances), so as to occupy the minimum of space, and all offsets, fittings, etc., required shall be provided at no additional cost to the Owner.

3.7 SECURING AND SUPPORTING

A. All piping shall be adequately supported to line and grade, with due provisions for expansion and contraction.

B. Piping shall be supported on approved clevis type, split ring, or trapeze type hangers properly connected to the structural members of the building.

C. All insulated piping shall be fitted with suitable steel protection saddles.

D. Perforated bar hangers, straps, wire or chains will not be permitted.

3.8 ISOLATION VALVES

A. All piping systems shall be provided with line size shut-off valves located at risers, at branch connections to mains, and at other locations as indicated and required.

3.9 TESTING OF PIPING SYSTEMS

A. During the progress of the Work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Engineer. The Engineer or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this Work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems, testing shall be accomplished prior to the application of any insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 24 hours at a pressure of 150 psi(g) or 150% of design pressure, whichever is greater. Tests shall be witnessed by the Engineer or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks, damage, or defects.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

3.10 PIPE CLEANING, FLUSHING AND PURGING REQUIREMENTS AND PROCEDURES

A. The hydronic system shall be flushed and purged by contractor:
   01 All mains, branches and zones shall be cleaned and treated per steps indicated below.
   02 Owner/Engineer shall be given 72-hour notice prior to each step being performed.

B. Pre-flush requirements: Purpose is to get system ready for flushing and purging:
   01 Piping must pass all required pressure testing and visual inspection for leaks.
   02 All pumps shall be tested for rotation and properly aligned and lubricated.

03 Chemicals planning on being used must have certificate of assurance and product cut sheets presented to the owner/engineer prior to being used. All chemicals must be approved by the state prior to being added to the system, FDA approved and meet ASTM D1384. Automotive grade chemicals are not allowed.

04 Bypass all coils and heat exchangers by connecting the supply and return piping together.

05 Fill entire system with clean fresh potable water.

C. The flush requirements: Purpose is to completely remove all debris, dirt and air from hydronic system.

01 Add system cleaner that contains detergent and emulsifying agents to properly remove grease, grime and other debris for steel pipe. Volume of cleaner used shall be about 10% of total volume.

02 System shall be circulated for a minimum of 48 hours with water velocities of a minimum of 5 ft/sec or greater. After completed all strainers shall be removed and cleaned thoroughly. House pumps are acceptable to circulate water. House pumps or pump seals that are damaged during the flushing process shall be replaced at no cost to the Owner.

03 The system shall be entirely drained and flushed out to remove all of the cleaner from the system as quickly as possible after cleaning to prevent debris from settling. All strainers shall be removed and thoroughly cleaned after no more dirt and cleaner is visible in the flushing water as it leaves the system.

D. Final fill:

01 All air vents shall be opened to allow air to escape during filling.

02 Reconnect all flex connections to equipment.

03 System shall be drained and filled with a local domestic/softened water mixture as required by chemical treatment supplier. System shall be filled with pressure reducing valve at the specified fill pressure.

E. Purging: Purpose is to remove all air from the system:

01 System shall be circulated for a minimum of one hour with water velocities of a minimum of 5 ft/sec or greater until all visible air is removed.

F. Final chemical addition: Purpose is to install chemicals during inhibitor as required:

01 After the above final fill and purging has been completed and accepted by the engineer/owner the final chemical addition can be done.

02 Chemical treatment shall be added to the system after thoroughly mixing water per the manufacturer’s recommendations. Chemical treatment shall include inhibitors. Quantities and concentrations of inhibitor/chemicals should be applied per the manufacturer’s specifications and approval submittals.

03 System water shall be tested for chemical inhibitor concentrations, reserve alkalinity and PH. Reports shall be submitted to engineer/owner.

04 All records and documentation shall be kept and given to the owner upon completion.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 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.

1.3 REFERENCES

A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.

B. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers; 2013 (Reapproved 2014).

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).

D. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).

E. ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems; 2019, with Addendum (2024).

F. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.

I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.

J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.

K. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

L. AWS B2.2/B2.2M - Specification for Brazing Procedure and Performance Qualification; 2016.

1.4 SUBMITTALS

A. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

B. Piping: Submit data on pipe materials, fittings, and accessories.

C. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

D. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes.

E. Welding Certificates: Submit per AWS B2.2/B2.2M and ASME BPVC-IX.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide for the systems as shown. Submit shop drawings of piping systems showing all traps, pipe sizes, and accessories; drawing to be marked "Approved" and signed by a representative of the Application Engineering Department of the condensing unit manufacturer. Pipe sizes shall be as recommended by unit manufacturer. Refer to piping schematic on Drawings.

2.2 MATERIAL

A. PIPE: Type ACR copper tubing, hard-drawn, per ASTM B280.

B. FITTINGS: Wrought copper per ASME B16.22.

C. JOINTS: Brazed joints with Sil-Fos filler metal per AWS A5.8M/A5.8.

2.3 ACCESSORIES

A. All accessories shall be UL listed and rated in accordance with AHRI 710.

B. On systems 7-1/2 tons and larger, each separate refrigerant circuit shall have a separate filter drier rated in accordance with AHRI 730 (I-P). Each filter drier shall have a replaceable core and a three valve bypass. The filter drier shall be full line size and installed in the refrigerant liquid line. The filter shall have a minimum 4-3/4 inches diameter shell with removable flange and gasket. Flange shall be tapped for 1/4 inch FPT access valve. Size filter-drier for maximum 2.0 psi pressure drop at evaporator operating temperature. Similar to Mueller Refrigeration model Drymaster micro-guard refillable filter series SD-485 through SD19217 or Sporlan catch-all.

C. On systems less than 7-1/2 tons, the filter drier shall be the sealed type; sizes as above. One drier per refrigerant circuit.

D. Liquid-Moisture Indicator shall be full line size, installed in liquid refrigerant line. Indicator shall be rated for the applicable refrigerant, system pressure and temperature; manufactured by Mueller Refrigeration or Sporlan.

E. Thermostatic expansion valve shall have adjustable super heat and be as manufactured by Sporlan.

F. Shut-off valves shall be bi-directional ball valves with welded body, brass ball with dual Teflon seals and integral relief port. Valves shall be rated for the applicable refrigerant, system pressure and temperature. Valves shall be manufactured by Mueller Refrigeration or Sporlan.

2.4 REFRIGERANT AND OIL

A. Contractor shall leave the refrigeration system with a full charge of refrigerant and oil and shall be responsible for the maintenance of a full charge of refrigerant and oil in the systems for a period of one year from date of Substantial Completion.

B. Should any leaks in the refrigeration system occur during the guarantee period, the Contractor shall eliminate such leaks and recharge system to a full charge of refrigerant and oil at no cost to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment and piping 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 on the Drawings or in the Specifications. Provide all items required as per manufacturer's requirements.

C. Refrigerant piping shall be installed in accordance with ASHRAE Std 15 and ASHRAE Std 34.

D. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required.

E. Braze joints per AWS B2.2/B2.2M and AWS A5.8M/A5.8 requirements.

F. Pipe shall be cut square, reamed and chamfered, and shall be free from burrs and obstruction. Pipe ends shall have full-bore openings and shall not be undercut.

G. Refrigerant piping located in areas other than the room or space where the refrigerating equipment is located shall be identified with pipe markers that meet labeling requirements of ASME A13.1. Markers shall be manufactured by W.H. Brady Company or approved equal. The pipe identification shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation. The minimum height of the identification lettering shall be 1/2". The pipe identification shall indicate the refrigerant designation and safety group classification of the refrigerant used in the piping system. For Group A2L and B2L refrigerants, the identification shall also include the following statement: "WARNING – Risk of Fire. Flammable Refrigerant." For Group A2, A3, B2, and B3 refrigerants, the identification shall also include the following statement: "DANGER – Risk of Fire or Explosion. Flammable Refrigerant." For any Group B refrigerant, the identification shall also include the following statement: "DANGER – Toxic Refrigerant".

H. Refrigerant piping routed indoors shall be installed at a minimum of 7'-3" above finished floor when located above an area affording passage of occupants.

I. Refrigerant piping located indoors shall be located within building elements such as a ceiling or wall space or within a protective enclosure unless installed a minimum of 7'-3" above finished floor, within 6'-0" of the associated equipment or within a refrigerant machinery room.

J. Provide shield plates for refrigerant pipes containing Group A2, A3, B2L, B2, and B3 refrigerants that are located in concealed locations where piping is installed in studs, joists, rafters or similar member spaces, and are located less than 1-1/2 inches from the nearest edge of the member. Shield plates shall be constructed of steel, have a minimum thickness of 16 gage, and shall extend two inches beyond the edge of the piping on each side.

K. Refrigerant pipe and joints installed in the field shall be exposed for visual inspection and testing prior to being covered or enclosed.

3.2 FIELD QUALITY CONTROL

A. Test piping and refrigeration system in accordance with ASME B31.5, ASHRAE Std 147, and this section.

B. The refrigerant piping system shall be tested as a whole or separate tests shall be conducted for the low-pressure side and high-pressure side of the piping system.

01 Pressure Test:

a. Pressure test shall be performed using dry nitrogen.

b. The means used to pressurize the refrigerant piping system shall have on its outlet side a test pressure measuring device and either a pressure-limiting device or a pressure-reducing device. The test pressure measuring device shall have an accuracy of +/- 3% or less of the test pressure and shall have a resolution of 5% or less of the test pressure.

c. The system shall be pressurized for a period of not less than 60 minutes. Additional test gas shall not be added to the system after the start of the test.

d. Test pressure shall be at least 110% of the system design pressure.

e. Test pressure shall not exceed 130% of the design pressure of any component in the system.

f. The system shall not show loss of pressure on the test measuring device throughout the entirety of the test.

02 Evacuation and Leak Test:

a. Evacuate moisture completely by applying a commercial vacuum pump. Moisture indicator shall indicate a completely moisture-free condition at time of final inspection.

b. The vacuum pump shall run until the system indicates a vacuum of 500 microns.

c. After achieving a vacuum, the system shall be isolated from the vacuum pump. The system pressure shall not rise for a minimum of 24 hours.

d. The system shall be flushed with the operating refrigerant and the vacuum pump connected and rerun to repeat the evacuation. Evaluation shall be performed under supervision of the Engineer.

C. Repair any and all leaks and retest as required.

END OF SECTION

SECTION 23 31 13

METAL DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Low pressure ductwork.

B. Exposed ductwork located indoors.

C. Duct leakage testing.

D. Duct system protection.

E. Duct system cleaning.

1.2 RELATED SECTIONS

A. Division 9 - Finishes: Weld priming, weather resistant, paint or coating.

B. Section 23 02 00 - Basic Materials and Methods for HVAC

C. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

D. Section 23 05 93 - Testing, Adjusting, And Balancing

E. Section 23 07 13 - Duct Insulation

F. Section 23 33 00 - Ductwork Accessories

G. Section 23 37 13 - Air Distribution Devices

1.3 REFERENCES

A. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2025a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

D. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

F. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

G. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

H. ASHRAE (FUND) ASHRAE Handbook - Fundamentals; Chapter 21 - Duct Design.

I. ASHRAE (HVACS) ASHRAE Handbook - HVAC Systems and Equipment; Chapter 19 - Duct Construction.

J. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

L. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

M. ICC (IECC) - International Energy Conservation Code.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

1.5 GENERAL DESCRIPTION

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.6 SUBMITTALS

A. Submit shop drawings, duct fabrication standards and product data under provisions of Division One.

B. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work.

C. The contract documents are schematic in nature and are to be used only for design intent. The contractor shall prepare sheet metal shop drawings, fully detailed and drawn to scale, indicating all structural conditions, all plumbing pipe and light fixture coordination, and all offsets and transitions as required to permit the duct to fit in the space allocated and built. All duct revisions required as a result of the contractor not preparing fully detailed shop drawings will be performed at no additional cost.

1.7 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain indicated clear size inside lining. Where offsets or transitions are required, the duct shall be the equivalent size based on constant friction rate.

B. Low Pressure: Low pressure ductwork shall be rated for an operating pressure of 2". Low pressure ductwork shall be defined as all return, exhaust, and outside air ducts, all supply ductwork associated with constant volume air handling units with a scheduled external static pressure of less than 2", and all supply ductwork downstream of terminal units in variable volume systems.

C. Medium Pressure: Medium pressure ductwork shall be rated for an operating pressure of 4". Medium pressure ductwork shall be defined as all supply ductwork extending from variable volume air handling units to terminal units in variable volume systems with air handling units having a scheduled external static pressure of less than 4". The supply ductwork of constant volume air handling units having a scheduled external static pressure greater than 2" and less than 4" shall be rated for medium pressure.

D. High Pressure: High pressure ductwork shall be rated for an operating pressure of 6", or the scheduled external pressure of the equipment it is connected to, whichever is greater. The supply ductwork of air handling units having a scheduled external static pressure greater than 4" shall be high pressure.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings, use sheet metal end caps on any lined duct exposed to the weather.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A653/A653M.

C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A480/A480M; Type 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

D. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B209, Alloy 3003, Temper H14.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Non-combustible and conforming to UL 181, Class 1 air duct materials.

B. Flexible Ducts: Flexmaster U.S.A., Inc. Type 5M, Thermaflex MKE, ATCO #036 or approved equal.

01 Flexible ducts shall be corrosive resistant galvanized steel formed and mechanically locked to inner fabric with minimum 1-1/2" thick, R-6 insulation. Flexible duct shall be rated up to at least 10 in.w.g. positive pressure and shall have reinforced metalized outer jacket to comply with UL 181, Class 1 air duct.

C. Sealants: Hard-Cast “iron grip” or approved equal, non-hardening, water resistant, fire resistive and shall not be a solvent curing product. Sealants shall be compatible with mating materials, liquid used alone or with tape or heavy mastic.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
01 For exposed stainless steel ductwork, provide matching stainless steel support materials.
02 For aluminum ductwork, provide aluminum support materials.

2.3 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with latest SMACNA (DCS) Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by approved shop drawings. Obtain engineer’s approval prior to using round duct in lieu of rectangular duct.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Use crimp joints with bead for joining round duct sizes 6 inch smaller with crimp in direction of airflow.

F. Use double nuts and lock washers on threaded rod supports.

2.4 EXPOSED DUCTWORK LOCATED INDOORS

A. Where ductwork is indicated to be exposed to view in occupied spaces, provide round or flat oval, double wall galvanized steel construction with spiral lockseam with perforated inner liner, United McGill Corporation model Acousti-k27 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Obtain manufacturer's inspection and acceptance of fabrication and installation of ductwork at beginning of installation.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Connect terminal units to medium or high pressure ducts with 18 inches maximum length of flexible duct. Do not use flexible duct to change direction.

E. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with strap or clamp.

F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

G. The interior surface of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.

H. All ductwork located outdoors shall be "crowned" to prevent water from ponding. Ref: Insulation for additional requirements.

I. Where ducts pass through non-rated floors, provide structural angles for duct support. Where ducts pass through non-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. Where ducts pass through rated interior partitions, rated exterior walls, or rated floors, install fire dampers or smoke dampers as required. Provide sleeves for dampers not provided with factory sleeve. Refer to Section 23 33 00 - Ductwork Accessories for fire and smoke damper requirements.

J. All angles shall be carried around all four sides of the duct or group of ducts. Angles shall overlap corners and be welded or riveted.

K. All ductwork shall be fabricated in a manner to prevent the seams or joints being cut for the installation of grilles, registers, or ceiling outlets.

L. All duct hangers shall be attached to building structure. Cutting slots in roof or floor decking for hanger straps to be cast in concrete is not acceptable.

3.2 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 5'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA (DCS).

3.3 DUCTWORK APPLICATION SCHEDULE

A. Ductwork materials shall be provided to comply with the following:

AIR SYSTEM	MATERIAL
Low Pressure Supply	Galvanized Steel, Aluminum

Buried Supply or Return	Concrete, Glass Fiber Reinforced Plastic
Medium and High Pressure Supply	Galvanized Steel
Return and Relief	Galvanized Steel, Aluminum
General Exhaust	Galvanized Steel, Aluminum
Grease Exhaust	Carbon Steel, Stainless Steel
Domestic Range Hood Exhaust	Galvanized Steel
Dishwasher/Ductwork Serving Type II Hoods	Stainless Steel
Shower/Locker Room/Dryer Vent/Paint Hood Exhaust	Stainless Steel
Fume Hood Exhaust	Stainless Steel
Corrosive Pool Environments	Aluminum
Welding Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel
Emergency Generator Ventilation	Carbon Steel

3.4 DUCTWORK HANGERS AND SUPPORTS

A. All ductwork shall be properly suspended or supported from the building structure. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Strap hanger shall be attached to the bottom of the ductwork, provide a minimum of two screws one at the bottom and one in the side of each strap on metal ductwork. The spacing, size and installation of hangers shall be in accordance with the recommendations of the latest SMACNA edition.

B. Wire shall not be used for permanent support or attachment components.

C. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor with sheet metal screws or rivets. The floor supports may also be secured to ducts by rods, angles or flat bar to the duct joint or reinforcing. Structural steel supports for duct risers shall be provided under this Division.

3.5 AIR DUCT LEAKAGE: (FROM SMACNA DUCT STANDARDS LATEST EDITION) TEST ALL DUCTWORK (DESIGNED TO HANDLE OVER 1,000 CFM) AS FOLLOWS:

A. Test apparatus
- 01 A source of high pressure air-a portable rotary blower or a tank type vacuum cleaner.
- 02 A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.

B. Test Procedures
- 01 Test for audible leaks as follows:
- 02 Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
  - a. Start the blower with its control damper closed.
  - b. Gradually open the inlet damper until the duct pressure reaches 1.5 times the standard designed duct operating pressure.
  - c. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

03 After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:
   a. Start blower and open damper until pressure in duct reaches 50% in excess of designed duct operating pressure.
   b. Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.
   c. Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
   d. Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which, must be corrected.

04 Testing Report
   a. Contractor shall provide a testing report for each air system to the engineer. The report shall indicate the completion of testing and compliance with testing specification.
   b. All duct testing reports shall be included in the final close out documents.

3.6 DUCT SYSTEM PROTECTION

A. Provide temporary closures at the ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation; provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

B. Provide temporary construction filters on air handling equipment and/or return air ductwork during construction to protect ductwork and equipment from dust.

C. Any ductwork stored on site with observable dirt or debris inside shall be cleaned by a third party.

D. If the air handling system has been operated without temporary construction filters or if the integrity of the temporary closures has been compromised, the contractor shall have the duct system cleaned per the following section.

3.7 DUCT SYSTEM CLEANING

A. For renovation projects and HVAC retrofit applications wherein existing duct systems are scheduled to be re-used, or where required by the Duct System Protection section above, the contractor shall have the existing duct systems cleaned in accordance with the current published standards of ASHRAE, NADCA ACR and as indicated below.

B. Duct system cleaning method used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.

C. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.

D. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

E. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

F. Duct cleaning method used shall not damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

G. Replace the fiberglass material if there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating.

H. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

I. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

J. Cleaning Report: Contractor shall provide a report to the Owner indicating the completion of duct cleaning per specification and areas of the duct system found to be damaged and/or in need of repair.

3.8 DUCT JOINTS AND SEAMS

A. All ductwork shall be constructed to Seal Class A, as referenced in SMACNA (DCS).

B. All non-welded joints and seams shall be sealed. This includes but is not limited to:
   01 Transverse joints.
   02 Longitudinal seams.
   03 Duct wall penetrations.
   04 Spin-ins, taps, and other branch connections.
   05 Access doors, access panels, and duct connections to equipment.

C. Openings for rotating shafts shall be sealed with bushings.

END OF SECTION

SECTION 23 33 00

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Volume control dampers.

B. Shutoff Dampers.

C. Round Duct Taps.

D. Back draft dampers.

E. Air turning devices.

F. Flexible duct connections.

G. Duct access doors.

H. Duct test holes.

1.2 RELATED WORK

A. Section 23 02 00 - Basic Materials and Methods for HVAC

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

C. Section 23 31 13 - Metal Ductwork

1.3 REFERENCES

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors duct test holes. Provide product data for hardware used.

C. Submit manufacturer's installation instructions under provisions of Division 1, for fire dampers and combination fire and smoke dampers.

PART 2 - PRODUCTS

2.1 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS), and as indicated.

B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.

C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/2 inch diameter rod in self aligning, universal joint, action flanged bushing, with set screw.

D. Fabricate single blade dampers for duct sizes to 9-1/2 x 24 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch.

01 Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

02 On outside air, return air, and all other dampers required to be low leakage type, provide galvanized blades and frames, seven inches wide maximum, with replaceable vinyl, EPDM, silicone rubber seals on blade edges and stainless steel side seals. Provide blades in a double sheet corrugated type construction for extra strength. Provide hat channel shape frames for strength and blade linkage enclosure to keep linkage out of the air stream. Construction leakage not to exceed 1/2%, based on 2,000 fpm and 4 inch static pressure.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.2 SHUTOFF DAMPERS

A. Fabricate in accordance with SMACNA (DCS), and as indicated.

B. Provide Class I multi-blade damper of parallel blade pattern for all ductwork systems which penetrate the building thermal envelope in accordance with ICC (IECC) and ASHRAE Std 90.1 I-P.

01 Damper shall be constructed of one-piece 16 ga. roll-formed galvanized steel hat-shaped channel frame. Blades shall be 14 ga. roll-formed galvanized steel, airfoil type. Blade edge seals shall be neoprene gaskets mechanically locked to blade edge. Bearings shall be 304 stainless steel, oil-impregnated and self-lubricating sleeve type, turning in extruded holes in damper frame.

C. Shutoff dampers shall have an air leakage rate not greater than 4 cfm/ft^2 of damper surface area at 1.0 in.w.g. and shall be labeled by an approved agency when tested in accordance with AMCA 500-D for such purpose.

2.3 ROUND DUCT TAPS

A. Taps to trunk duct for round flexible duct shall be spin-in fitting with locking quadrant butterfly damper, model no. FLD-B03 by Flexmaster or approved equal.

2.4 ACCEPTABLE MANUFACTURERS - BACKDRAFT DAMPERS

A. Greenheck.

B. American Warming and Vent.

C. Louvers and Dampers Inc.

D. Ruskin.

E. Pottorff.

F. Substitutions: Under provisions of Division One.

2.5 BACKDRAFT DAMPERS

A. Gravity back draft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

B. Fabricate multi-blade, parallel action gravity balanced back draft dampers of 16 gauge galvanized steel, or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

C. Gravity backdraft dampers shall have an air leakage not greater than 20 cfm/ft^2 where not less than 24 inches in either dimension and 40 cfm/ft^2 where less than 24 inches in either dimension. The rate of air leakage shall be determined at 1.0 in.w.g. when tested in accordance with AMCA 500-D for such purpose.

2.6 ACCEPTABLE MANUFACTURERS - AIR TURNING DEVICES

A. Young Regulator.

B. Titus.

C. Tuttle and Bailey.

D. Substitutions: Under provisions of Division One.

2.7 AIR TURNING DEVICES

A. On duct sizes less than 12 x 12, multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18 inch long removable key operator.

2.8 ACCEPTABLE MANUFACTURERS - FLEXIBLE DUCT CONNECTIONS

A. Metaledge.

B. Ventglass.

C. Substitutions: Under provisions of Division One.

2.9 FLEXIBLE DUCT CONNECTIONS TO AIR MOVING EQUIPMENT

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 6 inches wide, crimped into metal edging strip.

2.10 ACCEPTABLE MANUFACTURERS - DUCT ACCESS DOORS

A. Greenheck.

B. American Warming and Vent.

C. Ruskin.

D. Titus.

E. Substitutions: Under provisions of Division One.

2.11 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover. Insulation shall be replaceable without field cutting or patching.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

2.12 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Balancing Dampers

01 Provide at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing. Use splitter dampers only where indicated.

02 All regulators mounted on externally insulated ductwork shall have 16 gauge elevated platforms at least 1/8 inch higher than the thickness of the insulation. Damper shaft shall have Ventlock No. 607 bearing mounted on ductwork within elevated platform. If duct is inaccessible the operating handle shall be extended and the regulator installed on the face of the wall or ceiling. Where regulators are exposed in finished parts of the building, they shall be flush type, Ventlock No. 666. All regulators shall be manufactured by Ventlock, or approved equal.

03 All dampers in lined ductwork shall have bushing to prevent damper damage to liner.

C. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.

E. Provide gravity backdraft dampers or motorized shutoff dampers in accessible location nearest to exterior wall/roof penetrations and where indicated for all outdoor air intake and exhaust systems to automatically shut when the associated systems or spaces served are not in use.

F. Provide flexible duct connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Provide at least one inch slack at all flexible duct connections.

G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.

H. Provide duct access doors for inspection and maintenance of all fire dampers, smoke dampers, and combination fire/smoke dampers. Provide minimum 12 x 12 inch size access opening where duct size permits. All duct sizes that cannot accommodate a minimum 12 x 12 inch access opening shall be provided with a removable duct section to permit inspection and maintenance of the damper and its operating parts. Removable duct sections shall match the pressure class of the associated duct system, maintain 100 percent of the duct free area, and utilize gaskets and clamp type draw latches to allow removal and reinstallation without the use of tools.

I. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Ceiling and inline ventilators

B. Propeller wall axial ventilators

1.3 RELATED SECTIONS

A. Section 23 02 00 - Basic Materials and Methods for HVAC

B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment

C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

D. Section 23 05 93 - Testing, Adjusting, And Balancing

E. Section 23 09 63 - Energy Management and Control System (EMCS)

F. Section 23 33 00 - Ductwork Accessories

1.4 REFERENCES

A. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

B. AMCA 211 - Certified Ratings Program Product Rating Manual for Fan Air Performance; 2022, with Editorial Revision (2023).

C. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

E. AMCA 311 - Certified Ratings Program Product Rating Manual for Fan Sound Performance; 2016.

F. ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.

G. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

I. FLA (FBC-B) - Florida Building Code: Building (8th Edition); 2023, with Supplement (2024).

J. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. Miami (APD) - Approved Products Directory; Miami-Dade County; Current Edition.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

O. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.

P. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705.

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70.

F. Sound Power Level Ratings: Comply with AMCA 301. Test fans in accordance with AMCA 300. Fans shall be licensed to bear the AMCA 300 Seal.

G. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA 210.

H. Motors for fans that are not less than 1/12 hp (0.082 kW) and less than 1 hp (0.746 kW) shall be electronically commutated motors per ICC (IECC) and ASHRAE Std 90.1 I-P.

I. High Wind models shall be analyzed and stamped by a state license P.E. to the ASCE 7-16 Standard which meets the ICC (IBC), FLA (FBC-B), and Miami (APD) codes.

J. Each High Wind model is subject to be certified by a Nationally Recognized Testing Laboratory to ASTM E330/E330M.

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:
   01 Certified fan performance curves with system operating conditions indicated.
   02 Certified fan sound power ratings.
   03 Motor ratings and electrical characteristics plus motor and fan accessories.
   04 Materials, gages and finishes, include color charts.
   05 Dampers, including housings, linkages, and operators.
   06 Full color paint samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
   01 Roof framing and support members relative to duct penetrations.
   02 Ceiling suspension members.
   03 Method of attaching hangers to building structure.
   04 Size and location of initial access modules for acoustical tile.
   05 Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

H. Provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer`s designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer`s written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck Fan Corporation

B. Loren Cook Company

C. Pennbarry

D. ACME

E. Twin City Fan and Blower

2.2 GENERAL DESCRIPTION

A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

C. Provide factory baked-enamel finish coat after assembly. Color for roof mounted fans shall be chosen by Architect during the submittal process.

2.3 CEILING AND INLINE VENTILATORS

A. Ceiling and inline ventilators shall be direct drive or belt drive as indicated, centrifugal blower type. Fan wheel shall be constructed of galvanized steel and shall be dynamically balanced. The housing shall be constructed of minimum 20 gauge corrosion resistant galvanized steel and acoustically insulated for quiet operation. Blower and motor assembly shall be easily removable from the housing without disturbing the ductwork. The motor shall be permanently lubricated with built-in thermal overload protection and shall be factory tested prior to shipment. The ceiling ventilators shall be furnished standard with a powder-painted white steel grille.

B. Ventilators shall be certified and licensed to bear the AMCA Seal for Air and Sound Performance. Ventilator performance shall be based on tests and procedures performed in accordance with AMCA 211 and comply with the requirements of the AMCA Certified Ratings Program. Fan sound power level ratings shall be based on tests and procedures performed in accordance with AMCA 311 and comply with the requirements of the AMCA Certified Ratings Program. Ventilators shall be UL listed and CSA certified.

C. Accessories: The following accessories are required.
   01 Dampers:
      a. Aluminum backdraft damper.
      b. Motor-operated volume control damper.
      c. L listed ceiling radiation damper for ceiling fans comply with NFPA 90A rated for 3 hours
   02 Disconnect Switch: Nonfusible type with thermal overload protection.
   03 Speed Controls: Fan mounted, solid state speed controller.

2.4 PROPELLER WALL AXIAL VENTILATORS

A. Ventilator and assembly shall consist of propeller wall axial ventilator section, motorized damper section and accessories as scheduled.

B. Motorized Damper Section:
   01 Blades and frame shall be of aluminum construction.
   02 Blade edge seals shall be Ruskiprene type or equivalent, mechanically locked in extruded blade slots.
   03 Linkage shall be stainless steel, mounted in frame.
   04 Axles shall be square or hexagonal, stainless steel construction.
   05 Bearings shall be non-corrosive molded synthetic.
   06 Shaft shall be stainless steel.
   07 Damper actuator shall be mounted inside NEMA 4 type enclosure, factory wired through an internal aluminum conduit.

C. Gravity Damper Section:
   01 Blades and frame shall be of aluminum construction.

D. Propeller Wall Axial Ventilator Section:
   01 Fan motor shall be in TEFC type enclosure.

E. Wall collar shall be of aluminum construction.

F. Accessories: The following items are required.
   01 Disconnect Switch: Non-fusible type, with thermal overload protection mounted inside NEMA 4 enclosure, factory-wired through an internal aluminum conduit.
   02 Bird Screens: Removable ½ inch mesh, 16 gauge, aluminum or brass wire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

D. Refer to 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment for additional installation requirements.

E. Flexible duct connections and shutoff dampers are prohibited from being installed in duct systems conveying grease laden exhaust air per NFPA 96 requirements.

END OF SECTION

SECTION 23 34 39

HIGH-VOLUME, LOW-SPEED PROPELLER FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   01 Powerfoil X4.0

B. Summary of Work
   01 Provide the ceiling-mounted, circulation fans with the models scheduled and with the capacities indicated. The fan shall be furnished with standard mounting hardware and variable speed control to provide cooling and destratification.
   02 Installation of the fan, miscellaneous or structural metal work (if required), field electrical wiring, cable, conduit, fuses and disconnect switches, other than those addressed in the installation scope of work, shall be provided by others.

1.2 RELATED SECTIONS

A. Section 21 00 00 - Fire Protection

B. Section 23 02 00 - Basic Materials and Methods for HVAC

C. Section 23 05 13 - Common Motor Requirements for HVAC Equipment

D. Section 23 05 53 - Identification for HVAC Piping and Equipment

E. Section 26 02 00 - Basic Materials and Methods for Electrical

F. Section 28 46 00 - Fire Alarm and Smoke Detection System

1.3 REFERENCES

A. 10 CFR 430, Appendix U to Subpart B - Uniform Test Method for Measuring the Energy Consumption of Ceiling Fans; Current Edition.

B. AMCA 211 - Certified Ratings Program Product Rating Manual for Fan Air Performance; 2022, with Editorial Revision (2023).

C. AMCA 230 - Laboratory Methods Of Testing Air Circulating Fans For Rating And Certification; Current Edition.

D. CSA C22.2 No. 113 - Fans and Ventilators; 2018.

E. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

I. UL 507 - Electric Fans; Current Edition, Including All Revisions.

J. ROHS - Restriction of Hazardous Substances

K. NEMA - National Electrical Manufacturers Association

1.4 QUALITY ASSURANCE

A. Certifications
   01 The fan assembly, as a system, shall be Intertek/ETL-certified and built pursuant to the guidelines set forth by UL 507 and CSA standard 22.2 No. 113.
   02 The fan shall be compliant with NFPA 13, NFPA 72 and NFPA 70.
   03 Controllers shall comply with National Electrical Code (NEC) and Underwriters Laboratory (UL) standards and shall be labeled where required by code.
   04 Fans shall be tested to meet the minimum efficiency requirements of 10 CFR 430, Appendix U to Subpart B.
   05 Performance ratings shall conform to AMCA 211. Fans shall be tested and labele in accordance with AMCA 230 for performance ratings.

B. Manufacturer Qualifications
   01 The fan and any accessories shall be supplied by a company that has a minimum of ten (10) years of product experience.
   02 ISO 9001 - certified

1.5 SUBMITTALS

A. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods.

B. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information.

C. Revit Files: File provided for Contractor’s coordination drawings.

D. Installation Guide: The manufacturer shall furnish a copy of all operating and maintenance instructions for the fan. All data is subject to change without notice.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.

B. The fan and its components must be stored in a safe, dry location until installation.

1.7 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.

04 How the equipment achieves its purpose and necessary operating conditions.
05 Most likely failure modes, causes and corrections.
06 On site demonstration.

1.8 WARRANTY

A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge including transportation charges in accordance to the following schedule:
   01 HVLS fans scheduled as Powerfoil X4.0 Fans:
      a. Mechanical - 15 years
      b. Electrical - 7 years
      c. Labor - 1 year
   02 HVLS fans scheduled as Basic 6 Fans:
      a. Mechanical - 7 years
      b. Electrical - 3 years
      c. Labor - 1 year
   03 HVLS fans scheduled as Essence Fans:
      a. Mechanical - 10 years
      b. Electrical - 5 years
      c. Labor - 1 year

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Big Ass Fans

2.2 HIGH VOLUME, LOW SPEED FANS - BIG ASS FANS POWERFOIL X4.0

A. Complete Unit
   01 Regulatory Requirements:
      a. The entire fan assembly (with or without light kit) shall be Intertek/ETL-certified and built pursuant to the construction guidelines set forth by UL 507 and CSA C22.2 No. 113.
      b. The BAFCon controller shall be compliant with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) The device must accept any interference received, including interference that may cause undesirable operation.
   02 Sustainability Characteristics:
      a. The fan shall be designed to move an effective amount of air for cooling and destratification in a variety of applications (including industrial and agricultural) over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.

b. The BAFCon controller shall be designed to control Big Ass Fans and lighting systems from a secure, centralized location. The system shall be designed specifically for high volume, low speed Big Ass Fans to ensure maximum control. The system shall include optional SmartSense functionality to maximize energy savings. SmartSense shall provide the capability to automatically control the speed of Big Ass Fans using information from user-determined settings and built-in temperature and humidity sensors.

03 Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Onboard Fan Control

01 The onboard fan controller shall be constructed using a variable frequency drive (VFD) that is pre-wired to the motor and factory-programmed to minimize the starting and braking torques for smooth and efficient operation. The onboard controller shall be prewired to the motor using a short run of flexible conduit with a dedicated ground conductor to minimize electromagnetic interference (EMI) and radio frequency interference (RFI). A 15-ft incoming power cord shall be pre-wired to the controller with one of the following plugs: NEMA L6-20P Twist-Lock Plug, NEMA L6-30P Twist-Lock Plug, NEMA L15-20P Twist Lock Plug, NEMA L16-20P Twist-Lock Plug.

02 For fans with single-phase input, conversion to three-phase output takes place at the VFD.

C. Airfoil System

01 The fan shall be equipped with eight (8) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.

02 The fan shall be equipped with eight (8) Powerfoil winglets (standard) [<>] on the ends of the airfoils and eight (8) AirFences® positioned on the airfoils at the optimum location for performance. Both the winglets and AirFences shall be molded of a polypropylene blend. The standard color of the winglet and AirFence shall be “Safety Yellow.” Color shall be as scheduled and shall be coordinated with the architect and owner prior to ordering.

03 Airfoil Restraint System

a. All 20- to 24-ft diameter fans shall be equipped with a patented airfoil restraint system to provide redundant safety between the ends of the airfoils and the fan hub. The airfoil restraint system shall be available as an option on smaller diameter fans.

b. The airfoil restraint system shall be comprised of durable, lightweight nylon safety straps that shall extend from winglets through the airfoils and secure to the fan hub with 12-gauge stamped steel safety clips.

c. The straps shall be made of 1 in. wide heavy-duty nylon webbing rated for 825 lb. The loops at the ends of the straps shall be secured in a double-stitch pattern for reinforced durability.

d. The straps shall be precisely matched to each fan’s diameter, eliminating the need for a tensioning mechanism and reducing opportunity for noise.

e. The straps shall run along the inside of the airfoils for an uninterrupted look.

f. Safety clips are preattached to each winglet at the factory to comprise the outer anchor points and provide tension, while clips on the opposite end secure to threaded inserts incorporated in the fan hub.

D. Motor

01 The fan motor shall be an AC induction type inverter rated at 1725 RPM, 200-240/400-480 VAC, 50/60 Hz, three-phase.

02 The motor shall be totally enclosed, fan cooled (TEFC) with an IP44 NEMA classification. A NEMA 56C standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 32°F to 122°F ambient conditions.

03 The motor shall have a C-face attachment that shall enable technicians to detach the motor for easy field service. The C-face motor adapter shall be designed to work with the NitroSeal™ gearbox.

E. Gearbox

01 The fan gearbox shall be a NitroSeal™ Drive designed specifically for the Powerfoil X series. The gearbox shall include a high-efficiency, hermetically sealed, nitrogen-filled, offset helical gear reducer with two-stage gearing, a hollow output shaft, cast iron housing, double lip seals, high quality SKF Explorer Series bearings with crowned cages for optimal lubrication flow, and precision machined gearing to maintain backlash less than 11 arc-minutes over the life of the unit. Lubrication shall be high-grade, low-foaming synthetic oil with extreme pressure additives and a wide temperature range, and shall be lubricated for the life of the product (no oil changes required).

02 The gearbox shall be equipped with a hollow shaft threaded to accept a ¾” NPT fitting in which wiring, piping, etc., can be routed to below the fan. A standard junction box can be affixed to this hollow shaft to allow for installing optional features such as lights or cameras. The inclusion of the hollow shaft shall be specified at the time of order.

F. Mounting Post

01 The fan shall be equipped with a mounting post that provides a structural connection between the fan assembly and extension tube. The mounting post shall be formed from A36 steel, contain no critical welds, and be powder coated for corrosion resistance and appearance.

G. Mounting System

01 The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is installed to the mounting structure to ensure the fan will hang level from the structure.

02 The upper mount shall be of ASTM A-36 steel, welded construction, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.

03 All mounting bolts shall be SAE Grade 8 or equivalent.

H. Hub

01 The fan hub shall be 19” in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, eight (8) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.

02 The hub shall be secured to the output shaft of the gearbox by means of (10) high strength bolts. The hub shall incorporate five (5) safety retaining clips made of 1/4” thick steel that shall restrain the hub/airfoil assembly.

I. Safety Cables

01 The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of 3/8”.

02 The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4".
03 The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf.
04 Field construction of safety cables is not permitted.

J. Digital Variable Speed Wall Controller
01 The fan shall be equipped with a digital variable speed wall controller. The controller user interface shall be a wall-mounted, touch interface.
02 The controller shall be mounted to a standard rectangular or square outlet box.
03 A 150-ft CAT5 cable shall be provided for connecting the controller to the fan's VFD and to provide power to the controller.
04 The controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
05 The controller shall have an IP65 rating.
06 The controller shall provide fan start/stop, speed, and direction control functions.
07 The controller shall provide diagnostic and fault history information for the connected fan, as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
08 The controller interface shall be able to be secured with a passcode to prevent unauthorized access to fan controls and settings.
09 The controller shall operate out of the box without setup and upon connection to CAT5 cable.

K. BAFCon Controller
01 The fan shall have the option of operating with the BAFCon controller.
02 The digital controller user interface shall be a wall-mounted touchscreen with a 5-inch display and an 800 (RGB) x 480 pixel resolution.
03 The digital controller shall be mounted to a standard rectangular or square outlet box.
04 A 150-ft CAT5 cable shall be provided for connecting the digital controller to the fan's VFD, allowing for seamless communication between BAFCon and the VFD. The cable shall provide power to the digital controller.
05 The digital controller shall not require a 120 V power supply at the controller mounting location.
06 The digital controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
07 The digital controller shall support up to eight Powerfoil D fans controlled as a group or individually.
08 The digital controller shall provide fan start/stop, speed, and direction control functions.
09 The digital controller shall provide diagnostic and fault history information for each connected fan as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
10 The digital controller shall include optional SmartSense functionality to maximize energy savings. SmartSense shall provide the capability to automatically control the speed of Big Ass Fans using information from user-determined settings and built-in temperature and humidity sensors.
11 The digital controller interface shall be able to be secured with user and admin passcodes to prevent unauthorized access to fan controls and settings.
12 The digital controller shall include Bluetooth® functionality for receiving firmware updates from a mobile app. The app shall be supported by iOS® and Android™ mobile devices. The digital controller's Bluetooth functionality can be disabled if not needed or permitted.

13 BAFCon Multi-Fan Accessory Kit

a. If multiple fans will be installed, the BAFCon Multi-Fan Accessory Kit shall be available.

b. The kit shall include a two-screw RJ45 terminal block, a ¼ Watt, 120 Ohm termination resistor, RJ45 pass through splitters, and split-gland cord grips for connecting multiple fans to the controller.

c. The accessory kit shall include a two-screw RJ45 terminal block, a ¼ Watt, 120 Ohm termination resistor, RJ45 pass through splitters, and split-gland cord grips for daisy chaining multiple fans to the controller.

L. Fire Alarm Control Panel Integration

01 Includes a 10-30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

M. Guy Wires

01 Included for installations with extension tubes 4 ft or longer to limit the potential for lateral movement.

PART 3 - EXECUTION

3.1 PREPARATION

A. Fan location must have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.

B. Mounting structure must be able to support weight and operational torque of fan. Consult structural engineer if necessary.

C. Fan location must be free from obstacles such as lights, cables, or other building components.

D. Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.

E. Each fan requires dedicated branch circuit protection.

F. Before the BAFCon controller is installed, the fan system shall be installed by a factory-certified installer according to the instructions in the fan Installation Guide.

G. Install a rectangular or square outlet box at the BAFCon controller mounting location.

H. If the BAFCon controller will be mounted more than 250 ft from the fan or if multiple fans will be daisy chained, ensure the optional BAFCon Accessory Kit is included. The accessory kit shall be installed by a factory- certified installer according to the instructions included with the kit.

3.2 INSTALLATION

A. The fan and BAFCon controller shall be installed by a factory-certified installer according to the manufacturer’s Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle iron for bar joist applications. Contractor shall consult a structural engineer for installation methods outside the manufacturer’s recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.

B. Minimum Distances
   01 Airfoils must be installed at a minimum distance above the floor as recommended by the fan manufacturer.
   02 Installation area must be free of obstructions such as lights, cables, sprinklers or other building structures with the airfoils at least 2 ft clear of all obstructions.
   03 The structure the fan is attached to shall be capable of supporting the operational torque load indicated by the fan manufacturer.

C. The fan shall not be located where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems or radiant heaters.

D. In buildings equipped with sprinklers, including ESFR sprinklers, fan installation shall comply with all of the following:
   01 The maximum fan diameter shall be 24 ft.
   02 The HVLS fan shall be centered approximately between four adjacent sprinklers.
   03 The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft.
   04 All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72.

E. Mount the BAFCon controller to a flat, readily accessible surface that is free from vibration and away from foreign objects and moving equipment. The controller mounting location must meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.

F. If the SmartSense feature will be used, the BAFCon controller must not be mounted adjacent to or above a radiant heat source, near HVAC ventilation intakes/exhausts, on a poorly insulated exterior wall, or in a different temperature/humidity environment than the fans it will control. Additional mounting guidelines can be found in the Installation Guide.

END OF SECTION

SECTION 23 37 13

AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Ceiling air diffusers.

B. Wall registers and grilles.

C. Louvers.

D. Other air devices indicated on drawings and schedules.

1.2 RELATED SECTIONS

A. Section 08 91 00 - Louvers

B. Section 23 02 00 - Basic Materials and Methods for HVAC

C. Section 23 05 93 - Testing, Adjusting, And Balancing

D. Section 23 07 13 - Duct Insulation

E. Section 23 31 13 - Metal Ductwork

F. Section 23 33 00 - Ductwork Accessories

1.3 REFERENCES

A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

C. AMCA 540 - Test Method for Louvers Impacted by Wind Borne Debris; 2013.

D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.

E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.

F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).

J. ASTM D870 - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion; 2015.

K. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air distribution devices of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
   01 AHRI Compliance: Test and rate air distribution devices in accordance with AHRI 880 (I-P).
   02 ASHRAE Compliance: Test and rate air distribution devices in accordance with ASHRAE Std 70.
   03 AMCA Compliance: Test and rate louvers in accordance with AMCA 500-L.
   04 AMCA 540 - Test Methods for Louvers Impacted by Wind Borne Debris with Enhanced Protection Approval.
   05 AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers.
   06 AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
   07 NFPA Compliance: Install air distribution devices in accordance with NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
   08 ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   09 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   10 IBC - International Building Code.
   11 IMC - International Mechanical Code.
   12 UMC - Uniform Mechanical Code.

1.5 DEFINITIONS

A. Hurricane-prone regions:
   01 The U.S. Atlantic Ocean and Gulf of Mexico coasts where the ultimate design wind speed for Risk Category II Buildings is greater than 115 mph;
   02 Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

B. Wind-borne debris region: Areas within hurricane-prone regions located:
   01 Within 1 mile of the coastal mean high water line where the ultimate design wind speed is 130 mph or greater; or
   02 In areas where the ultimate design wind speed is 140 mph or greater. For Risk Category II buildings and structures and Risk Category III building and structures, except health care facilities, the wind-borne debris region shall be based on Figure 1609.3(1). For Risk Category IV buildings and structures and Risk Category III health care facilities, the wind-borne debris region shall be based on Figure 1609.3(2).

C. Ultimate design wind speed - The ultimate design wind speed for the determination of the wind loads shall be determined by Figures 1609.3(1), 1609.3(2) and 1609.3(3) of ICC (IBC).

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for the following:
   01 Air Distribution Devices
      a. Schedule of air distribution devices indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
      b. Data sheet for each type of air distribution devices, and accessory furnished; indicating construction, finish, and mounting details.
      c. Performance data for each type of air distribution devices furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
   02 Louvers
      a. Manufacturer's product data including performance data.
      b. Preparation instructions and recommendations.
      c. Storage and handling requirements and recommendations.
      d. Installation methods.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air distribution device and louver, indicating materials, construction, dimensions, accessories, and installation details.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air distribution devices wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air distribution devices and louvers in original cartons and protect from weather and construction work traffic in accordance with manufacturer’s instructions. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 WARRANTY

A. Warrant the installation of the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or nonconforming workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - AIR DEVICES

A. Titus Company

B. Metalaire Industries, Inc.

C. Nailor Industries

D. Krueger

E. Price

2.2 AIR DEVICES

A. Unless otherwise indicated, provide manufacturer's standard air devices when shown of size, shape, capacity, type and accessories indicated on drawings and schedules, constructed of materials and components as indicated and as required for complete installation and proper air distribution.

B. Provide air devices that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Unless noted otherwise on drawings, the finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D870 Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inch-pound force applied.

D. Provide air device with border styles that are compatible with adjacent ceiling or wall system, and that are specially manufactured to fit into the wall construction or ceiling module with accurate fit and adequate support. Refer to architectural construction drawings and specifications for types of wall construction and ceiling systems.

E. Provide integral volume damper with roll formed steel blades where indicated on drawings or schedules. Dampers shall be opposed blade design with a screwdriver slot or a concealed lever operator for adjustment through the face of the air device.

F. Air devices designated for fire rated systems shall be pre-assembled with UL classified radiation damper and thermal blanket. Fire rated air devices shall be shipped completely assembled, one assembly per carton; each assembly shall be enclosed in plastic shrink wrap with installation instructions.

2.3 ACCEPTABLE MANUFACTURERS - LOUVERS

A. Ruskin Manufacturing Company

B. Greenheck Company

C. Louvers and Dampers, Inc.

D. Pottorff

E. Arrow

2.4 LOUVERS

A. Louvers not located in hurricane-prone regions or wind-borne debris regions shall meet the requirements of AMCA 500-L for Laboratory Methods of Testing Louvers for Rating and be drainable stationary type louvers.

B. Louvers located in hurricane-prone regions shall meet the requirements of AMCA 550 for High Velocity Wind Driven Rain without the use of a control damper.

C. Louvers located in wind-borne debris regions within 30 feet of grade shall meet the requirements of AMCA 540 for Large Missile Impact.

D. Provide louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

E. Provide louvers that have minimum free area and maximum pressure drop as indicated on drawings.

F. Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to architectural construction drawings and specifications for types of substrate.

G. Coordinate with Architect for finish and color.

H. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All interior surfaces of all air devices shall be painted flat black.

B. See floor plans for type, neck size and CFM of air for all air distribution devices.

C. Install all air distribution devices as detailed on plans and in accordance with manufacturer’s recommendations.

D. The backside of all air devices shall be insulated with taped and sealed external duct wrap to match the insulation thickness and R-value of the ductwork connecting to the air device. Refer to 23 07 13 - Duct Insulation.

E. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.

F. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

G. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.

H. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

I. Touch-up, repair or replace any damaged products prior to substantial completion.

END OF SECTION

SECTION 23 37 23

HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Hooded gravity ventilators.

1.3 RELATED SECTIONS

A. Section 23 02 00 - Basic Materials and Methods for HVAC

B. Section 23 05 93 - Testing, Adjusting, And Balancing

C. Section 23 33 00 - Ductwork Accessories

1.4 REFERENCES

A. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2010.

B. ASCE 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

E. FLA (FBC-B) - Florida Building Code: Building (8th Edition); 2023, with Supplement (2024).

F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

I. Miami (APD) - Approved Products Directory; Miami-Dade County; Current Edition.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.5 QUALITY ASSURANCE

A. Approved ISO 9001 compliant manufacturer listed in this section with minimum 10 years' experience in manufacture of similar products in successful use in similar applications.

B. Nationally Recognized Testing Laboratory Compliance (NRTL): Components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

C. High Wind models shall be analyzed and stamped by a state license P.E. to the ASCE 7-16 Standard which meets the ICC (IBC), FLA (FBC-B) and Miami (APD) codes.

D. Each High Wind model is subject to be certified by a Nationally Recognized Testing Laboratory to ASTM E330/E330M.

E. Shutoff dampers shall be provided as required by ASHRAE Std 90.1 I-P and ICC (IECC).

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:
   01 Dimensional drawings and product data on each ventilator.
   02 Materials, gages and finishes, include color charts.
   03 Dampers, including housings, linkages, and operators.
   04 Full color paint samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
   01 Roof framing and support members relative to duct penetrations.
   02 Ceiling suspension members.
   03 Method of attaching hangers to building structure.
   04 Size and location of initial access modules for acoustical tile.
   05 Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

H. Provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer's instructions.

B. Lift and support units with the manufacturer`s designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer`s written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck Fan Corporation

B. Loren Cook Company

C. Pennbarry

D. ACME

E. Twin City Fan and Blower

2.2 HOODED GRAVITY VENTILATORS

A. Hooded gravity ventilators shall be aluminum construction unless noted otherwise.

B. Hood shall be constructed of precision formed, arched panels with interlocking seams.

C. Vertical end panels shall be fully locked into hood end panels.

D. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.

E. Internal reinforcement and bracing shall be provided as required.

F. Accessories: The following accessories are required.
   01 Bird Screens: Removable ½ inch mesh, 16 gauge, aluminum wire.

02 Dampers: Gravity backdraft damper or motorized shutoff damper mounted in accessible location. Refer to 23 33 00 - Ductwork Accessories.

03 Roof Curbs: Prefabricated, minimum 12 inch high, heavy-gauge, galvanized steel; mitered and welded corners; 2 inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2 inch wood nailer. Curb height shall be increased as required to maintain a minimum height of 8 inches above adjacent roofing surface. Size as required to suit roof opening and ventilator base. Roof curb shall match roof slope so that the curb is level.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

D. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance prior to installation.

E. Install the roof curb as required by the job conditions and as recommended by the manufacturer and install proper flashing and counterflashing. See details on the Drawings.

F. Set ventilators in place, taking care to protect the adjacent roofing, and make all ductwork connections.

G. Ventilator installation shall comply with NFPA 90A requirements.

END OF SECTION

SECTION 23 41 00

AIR FILTERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC are included as a part of this Section as though written in full in this document.

1.2 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.

1.3 REFERENCES

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.

B. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 - PRODUCTS

2.1 FILTERS

A. Air filters shall be high efficiency ASHRAE pleated panels consisting of synthetic media, welded wire media support grid, and beverage board enclosing frame, AAF PREpleat M13, 2-inch thick or approved equal.

B. APPROVED MANUFACTURERS
   01 American Air Filter.
   02 Camfil.
   03 Airguard Industries, Inc.
   04 Cambridge.
   05 Filtration Group

2.2 LOW VELOCITY FILTER SECTION

A. Filters shall be of the throwaway cartridge type in 2-inch frames. When installing multiple filters into slide-in frames tape adjacent filters together with duct tape to prevent bypassing of air around the filter. Media shall be rated at 500 feet per minute.

B. Filtering media shall be formed of non-woven reinforced synthetic type filtering media bonded to 96% open area media support grid folded into a non-creased radial pleat design. The filter pack shall be bonded to the enclosing frame to prevent air bypass. Minimum Efficiency Reporting Value of MERV 13 when evaluated under the guidelines of ASHRAE Std 52.2. Initial resistance shall not exceed 0.30 inches water gauge at 500 fpm face velocity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Filters shall be provided upstream of all cooling coils or other devices with wetted surfaces through which air is supplied to occupiable spaces per ASHRAE Std 62.1.

B. Install differential pressure switch to activate "Filter Dirty" light when pressure difference across filters reaches 0.5 inches w.g. (adjustable). Locate "filter dirty" lights in mechanical rooms with identifying label.

C. Refer to Section 23 02 00 for additional filter information.

END OF SECTION

SECTION 23 62 13

AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC is included as a part of this Section as though written in full in this document.

1.2 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.

1.3 REFERENCES

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. AHRI 340/360 (I-P) - Standard for Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment; 2022.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 QUALITY ASSURANCE

A. Unit shall be factory tested, shall be UL-labeled and rated in accordance with AHRI 340/360 (I-P).

B. Unit construction shall comply with ASHRAE Std 15.

C. Unit wiring shall comply with NFPA 70.

D. Unit shall meet or exceed minimum efficiency requirements in accordance with ICC (IECC) and ASHRAE Std 90.1 I-P.

1.5 SUBMITTALS

A. Submit Shop drawings and product data under provisions of Division One.

B. Shop drawings shall indicate components, dimensions, weights, required service clearances, and location and sizes of field connections. Indicate equipment, piping and connections and accessories required for complete system.

C. Product data shall include rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

D. Submit manufacturer's installation instructions.

E. For roof mounted units provide delegated design submittal for equipment anchorage as required in specification 23 02 00 - Part 1.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation data.

B. Include start-up instructions, maintenance data, controls, and accessories. Include trouble-shooting guide.

C. Submit maintenance data.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

B. Accept products on site and inspect for damage.

C. Protect units from physical damage. Factory shipping covers and skids shall be kept in place until installation. Store in a clean dry place and protect from weather and construction traffic.

1.8 WARRANTY

A. Provide the entire condensing unit with parts and labor warranty by the equipment manufacturer for one year from start-up or 18 months from date received on site.

B. Provide all components of the refrigeration circuit with parts and labor warranty by the equipment manufacturer for five years.

1.9 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.

06 On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lennox

B. Carrier

C. York

D. Trane

E. Aaon

F. Daikin

2.2 AIR-COOLED CONDENSING UNITS

A. Air-cooled condensing unit shall be designed for use with split system having a remote direct-expansion (DX) cooling coil mounted in evaporator fan unit and rated in accordance with either AHRI 210/240 or AHRI 340/360 (I-P). Capacity shall be as called for on the Drawings when matched to the appropriate evaporator coil.

B. Condensing unit shall consist of high-efficiency hermetic compressor, air-cooled condenser with quiet fan, factory wired controls, R-454B or R-32 refrigerant and refrigeration circuit and valves.

C. Cabinet shall be heavy-gauge galvanized steel with bonding primer and baked-enamel finish coat. The entire cabinet shall be protected from rust.

D. Compressor shall be protected from excessive current and temperatures and shall be provided with a thermostatically controlled crankcase heater to operate only when needed for protection of the compressor. Compressor shall be mounted on resilient rubber isolators. Compressor shall be located in compartment isolated from condenser fan and coil. Provide a high-capacity dryer in the system to remove moisture and dirt.

E. Condenser fan shall be directly connected to a weather-protected, quiet, high-efficiency motor. Fan guard shall be provided and shall be protected from rust by PVC finish. Condenser coil shall be aluminum fin with copper tube.

F. Connections for refrigerant suction and liquid lines shall be extended outside the cabinet and provided with service valves with gauge connections.

G. Power connections shall be made to the connectors located inside the electrical connection box.

H. Standard operating and safety controls shall include high-pressure switch, low pressure switch, compressor overload service, and solid-state timed-off control.

2.3 AUXILIARY EQUIPMENT

A. Auxiliary equipment shall consist of refrigerant lines prepared for the unit involved. These lines shall be cleaned, dried, and pressurized at the factory.

B. Low ambient kit to allow operation at outside temperature below 35 deg. F (2 deg. C) shall be provided.

C. Expansion valve shall be provided with the evaporator coil.

D. Provide thermostat to match the requirements of the job. Thermostat shall provide subbase with Heat-Cool-Off and Fan On-Auto switch. See section on controls for other related requirements.

E. Provide polyethylene structural base designed for that service, and intended to support the unit and eliminate vibration transmission.

F. Provide hard-start kit with unit.

G. Provide hail guards for condenser coils.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All HVAC equipment shall be installed as per manufacturer's printed installation instructions.

B. Refer to specification 23 02 00 - Part 1 for anchorage requirements for roof mounted equipment.

C. All items required for a complete and proper installation are not necessarily indicated on the Drawings or in the Specifications. Provide all items required as per manufacturer's requirements.

D. Install the condensing unit on proper foundation as shown on the Drawings, and in location that will not restrict the air entry or discharge from the unit.

E. Install refrigerant lines as recommended by the manufacturer, taking care not to lose the refrigerant charge contained in the lines, or allow air to enter the lines or equipment. Locate the lines in such a way as to not obstruct access to the condensing unit or other equipment. Lines located underground or under concrete shall be installed in a PVC sleeve for protection.

F. Provide electrical connections as required by the applicable codes. Provide control wiring required. All power wiring and control wiring shall be in conduit and located so as not to obstruct access to the unit or other equipment.

3.2 TESTING

A. Operate the condensing unit and the system to assure that unit is operating properly and without excessive noise and vibration.

B. Read and record the power draw and the refrigeration suction and liquid pressures as required by Section 23 05 93 - Testing, Adjusting, And Balancing.

END OF SECTION

SECTION 23 72 19

ENERGY RECOVERY VENTILATOR - CORE STYLE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Indoor/outdoor total enthalpy energy core style air-to-air fixed heat exchanger.

1.3 RELATED SECTIONS

A. Section 23 02 00 - Basic Materials and Methods for HVAC

B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment

C. Section 23 05 26 - Variable Frequency Motor Speed Control for HVAC Equipment

D. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

E. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

F. Section 23 05 93 - Testing, Adjusting, And Balancing

G. Section 23 09 63 - Energy Management and Control System (EMCS)

H. Section 23 31 13 - Metal Ductwork

I. Section 23 33 00 - Ductwork Accessories

J. Section 23 34 00 - HVAC Fans

K. Section 23 41 00 - Air Filters

1.4 REFERENCES

A. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.

B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

D. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation; 2019.

E. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).

F. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2025.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

J. UL 1812 - Ducted Heat Recovery Ventilators; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. Underwriters Laboratories, Inc. (UL): Provide energy recovery equipment with electrical and control components listed and labeled by UL.

B. National Fire Protection Association (NFPA): Provide energy recovery equipment that is in compliance with requirements of NFPA 90A.

C. Certifications:
   01 Performance: Entire unit shall be ETL certified per UL 1812 for core heat exchanger units and shall bare an ETL label. All heat transfer components shall be AHRI 1060 (I-P) certified.
   02 Cross Leakage: Provide AHRI 1060 (I-P) certified data on cross Leakage tests.

D. Installation and Start-up: Provide services of a representative authorized by the manufacturer to perform inspection, start-up and certification of each unit.

1.6 SUBMITTALS

A. Provide complete submittal data for each unit including, but not limited to the following:
   01 Materials of construction, types and gauges of frame, panels, and supports.
   02 Dimensions and weights.
   03 Points of all utility connections.
   04 Sound data, inlet, outlet and casing radiation.
   05 Complete fan performance curves for both supply and exhaust and exhaust air. Air side data including fan types and sizes and air side performance tables or charts.
   06 Cross contamination test data.
   07 Performance data with psychometric points at all scheduled conditions for both summer and winter.
   08 Electrical data including wiring diagrams.
   09 Control components and sequences.
   10 Combined efficiency data per AHRI guideline V-2003 including RER, COP, unitary net cooling and heating, unitary EER and CEF.

B. For roof mounted units provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling: Handle heat recovery equipment to prevent damage, denting and scoring. Do not install damaged equipment. Replace damage equipment with new.

B. Storage: Store equipment and components in a clean dry place. Protect from the weather, dirt, water and construction debris, and physical damage.

1.8 WARRANTY

A. Provide a warranty by the equipment manufacturer for five years from date of shipment from defects in material and workmanship when used in a proper and normal manner. Manufacturer shall have the option to repair or replace any defective part.

B. Provide a warranty by the equipment manufacturer for the enthalpy core against mechanical defects and performance degradation for a period of ten years from date of manufacturer's start-up. Warrant that the total effectiveness of the enthalpy energy core will be within 5% of the published performance data at the end of ten years when tested in the system. Include in the warranty labor and materials to correct or remedy enthalpy energy core that are found to be defective in performance.

1.9 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck

B. Venmar Ventilation, Inc.

C. RenewAire

D. ConsERV

E. Oxygen8

2.2 INDOOR/OUTDOOR TOTAL ENTHALPY CORE STYLE AIR-TO-AIR FIXED HEAT EXCHANGER

A. Unit shall be fully assembled at the factory and consist of a double wall insulated metal cabinet, downturn outdoor air intake weatherhood with metal mesh filters, enthalpy core, motorized intake damper, motorized exhaust damper, sensors, curb assembly, frost control, electric preheater, filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

B. Cabinet Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
   01 Outside casing: Unit's exterior shall be supplied from the manufacturer using 18 gauge G60 galvanized steel pre-painted in color as selected by project architect Exterior finish shall be subjected to a salt spray test per ASTM B117 and evaluated using ASTM D714 and ASTM D610 showing no observable signs of rust or blistering until reaching 2,500 hours.
   02 Internal Assemblies: 18 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

C. Access doors shall be hinged with airtight closed cell foam gaskets.

D. Shall have factory-installed duct flanges on all duct openings.

E. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
   01 Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
      a. Thickness: 1 inch (25 mm)
      b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C411.
      c. Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.

F. Enthalpy Energy Core: Core shall be of total enthalpy and shall be removable from the cabinet. The core shall consist of a galvanized steel framework (designed to produce laminar air flow through the core). The core media shall be a corrugated hydroscopic resin in a galvanized steel framework and be removable for servicing. Performance criteria are to be as specified in AHRI 1060 (I-P), complying with the Combined Efficiency data in the submittal.

G. Supply Air and Exhaust Air blower assemblies: Blower assemblies consist of an electric motor and a belt driven or direct drive blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125 inch thick neoprene vibration isolators. Refer to equipment schedules for blower drive type.

H. Control panel / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.

I. Frost control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10ºF and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

J. Electric preheater shall be provided for frost control of the energy core. Preheater assembly shall include a thermostat and pressure sensor on the core assembly to initiate frost control sequence. Preheater shall comply with UL 1996 and be constructed on a galvanized steel frame.

K. Motorized dampers / Exhaust Air, Intake Air: Motorized dampers of low leakage type shall be factory installed.

L. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed as specified.

M. Curb Assembly: A curb assembly made of 14 gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly. Provide minimum 14 inch high curb. Curb height shall be increased as required to maintain a minimum height of 8 inches above adjacent roof surface.

N. Blower:
   01 Blower section construction, Supply Air and Exhaust Air: Belt drive motor and blower units shall be assembled onto a 14 gauge galvanized steel platform and must have neoprene vibration isolation devices. Direct drive motor and blower units shall be assembled with neoprene vibration isolation devices.
   02 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
   03 Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
   04 Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow that are mechanically attached to shaft with set screws.
   05 Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210.

O. Motors:
   01 General: Blower motors greater than 3/4 horsepower shall be “NEMA Premium™” unless otherwise indicated. Minimum compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
   02 Motors shall be 60 cycle, single, or three phase, voltage as called for on mechanical equipment schedule.

P. Unit Controls

01 The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heat recover ventilation system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.

02 Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.

a. Operating protocol: The DDC shall be factory-programmed for BACnet MSTP for monitoring of the unit's status and control of the unit's functions.

03 Variable Frequency Drive (VFD) Unit shall have factory installed variable frequency for modulation of the blower motors. The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

04 Sensors:

a. Dirty Filter Sensor
b. Temperature Sensors- OAI, EAW, RAI, OAAW, OAD
c. Pressure Sensor- OAW-P, OAF-P, EW-P, EF-P
d. Current Sensor- OAF-A, EF-A

Q. Filters

01 Unit shall have permanent washable metal filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 13 disposable pleated filters shall be provided in the intake air stream and MERV 11 filters in the exhaust air stream.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heat recovery units in accordance with the equipment manufacturer's written instructions.

B. Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.

C. Locations for equipment shown on the drawings are approximate. Locate units so that they may be adequately serviced and repaired.

D. Block off or cap or otherwise seal openings in the cabinet to prevent entry of dirt and debris until connections are made.

E. Set each unit level and straight.

F. Remove all shipping blocks and restraints.

G. Open access panels and inspects for any abnormalities.

H. Make condensate drain connection. Verify that drain in properly trapped, vented and sloped to floor drain as shown on the drawings.

I. Make duct connections using flexible connectors. Verify that duct is independently and adequately supported.

J. Clean the exterior of each unit to remove dirt, debris, etc.

3.2 AUTHORIZED START-UP, TEST AND ADJUST

A. Provide authorized representative of the manufacturer to inspect the assembly and installation of each unit. Perform no start-up, tests, or adjustments on a unit until the representative determines that the unit has been properly assembled and installed.

B. The representative shall start-up, test, and adjust units. The representatives shall perform operational checks to make certain that all equipment and controls of the systems are operating properly. If defects or improper adjustments are found, they shall be corrected, and the tests shall be repeated.

C. The representative shall prepare and provide a written start-up report to include any measurements taken, test results obtained, or corrective actions required.

3.3 TRAINING

A. Provide training by a factory authorized representative on the operation, repair and maintenance of the system.

B. Submit training and operating manuals, spare parts lists and component drawings bound together in a hard cover binder.

C. Submit three copies of the operation, training, and maintenance manual.

3.4 SERVICES

A. Provide manufacturer's representative inspection services every six months during the warranty period for the enthalpy cores.

B. Provide services including:
   01 Verification of correct alignment of the seals,
   02 Inspection and replacement of seals and drive belts, if necessary,
   03 Verification of proper operation of controls.
   04 Lubrication of bearings.
   05 General condition of the whole unit, including cleanliness of enthalpy core, casing, and filters.

C. Services shall not include normal preventative maintenance services normally performed by the Owner, such as filter replacement, fan belt replacement.

D. Representative shall prepare and provide to the Owner a brief written report for each site visit. Report shall include conditions that the Owner needs to correct such as dirty filter, damage to the unit from outside sources, loose fan belts, etc.

END OF SECTION

SECTION 23 81 26

SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Indoor air conditioning units with microprocessor-based controls.

B. Outdoor remote mounted air-cooled condensing units

C. The system shall have a total cooling capacity and a sensible cooling capacity as indicated in the Mechanical Schedules.

D. The unit is to be supplied for operation on a power supply as indicated in the Mechanical Schedules and the Electrical drawings.

1.3 RELATED SECTIONS

A. Section 23 02 00 - Basic Materials and Methods for HVAC

B. Section 23 05 29 - Hangers and Supports for Piping and Equipment - HVAC

C. Section 23 05 13 - Common Motor Requirements for HVAC Equipment

D. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

E. Section 23 07 19 - HVAC Piping Insulation

F. Section 23 23 00 - Refrigerant Piping

G. Section 23 41 00 - Air Filters

H. Section 23 05 93 - Testing, Adjusting, And Balancing

I. Section 23 21 13 - Above Ground Hydronic Piping

1.4 REFERENCES

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.

C. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

E. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

I. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

J. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.5 QUALITY ASSURANCE

A. The unit shall be approved and listed by Underwriters' Laboratories, Inc. Unit performance shall be certified in accordance with AHRI 210/240.

B. The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, "Hi-Pot" Test (two times rated voltage plus 1000 volts, per NRTL agency requirements), and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

C. System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for "Heating and Cooling Equipment" and marked with the CSA c-us logo (60Hz only).

D. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705.

E. UL Compliance: Fans and components shall be UL listed and labeled.

F. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

G. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

H. Electrical Component Standard: Components and installation shall comply with NFPA 70.

I. Sound Power Level Ratings: Comply with AMCA 301. Test fans in accordance with AMCA 300. Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

J. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA 210.

1.6 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:
   01 Certified fan performance curves with system operating conditions indicated.
   02 Certified fan sound power ratings.
   03 Motor ratings and electrical characteristics plus motor and fan accessories.
   04 Materials, gages and finishes, include color charts.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

E. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

F. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

G. For roof mounted outdoor units provide delegated design submittal for equipment anchorage as required in specification 23 02 00 – Part 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until filters are in place, bearings lubricated, refrigeration piping has been tested and charged and fan has been test run under observation.

1.9 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.

04 How the equipment achieves its purpose and necessary operating conditions.
05 Most likely failure modes, causes and corrections.
06 On site demonstration.

1.10 WARRANTY

A. Provide a full parts, labor, and refrigerant warranty by the equipment manufacturer for one year from start-up or 18 months from shipment, whichever occurs first.

B. Provide a full parts warranty by the equipment manufacturer for five years, effective from date of factory start-up and certification.

C. Provide a compressor parts warranty by the equipment manufacturer for seven years, effective from date of factory start-up and certification.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide an indoor wall-mounted, factory assembled, pre-charged, pre-wired, tested and ready to operate air conditioning unit.

2.2 APPROVED MANUFACTURERS

A. Daikin

B. Trane/Mitsubishi

C. Hitachi

D. Toshiba

E. Samsung

F. LG

G. York/JCI

2.3 WALL-MOUNTED INDOOR UNIT

A. GENERAL
01 The unit shall be a wall-mounted style indoor unit with outlet vane and return inlet grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. UNIT CABINET
01 The cabinet shall be formed from high strength molded high impact, non-metallic material with smooth finish, flat front panel design with access for filter. Cabinet color shall be white. The unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.

02 The cabinet shall be designed so all components are easily accessible for service and maintenance through either the front or rear of the unit. Units that are not fully accessible from front and rear or not serviceable in place shall be unacceptable.

C. FAN AND AIR DISTRIBUTION

01 The air distribution system shall be constructed with a quiet, cross flow direct-drive fan assembly. The single fan motor shall be high-efficiency type, equipped with permanently lubricated bearings. The fan shall be capable of a minimum of three speeds for airflow modulation (High, Med, Low) and Sleep. Dehumidification shall utilize the lower fan speed.

02 Unit shall be provided with an integral, motorized, multi-position, air sweep vane to provide uniform, adjustable vertical air distribution. Air sweep vane operation shall be user selectable using the unit controller.

03 Unit shall be provided with a manually adjustable guide vane for horizontal air distribution.

D. FILTER

01 The filter shall be an integral part of the system, located within the cabinet and serviceable from the front. The filters shall be half-inch thick, washable type.

E. COIL

01 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.

02 The tubing shall have inner grooves for high efficiency heat exchange.

03 All tube joints shall be brazed with phos-copper or silver alloy.

04 The coils shall be pressure tested at the factory.

05 A condensate pan and drain shall be provided under the coil.

06 The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.

07 Both refrigerant lines to the indoor units shall be insulated.

F. ELECTRICAL

01 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

02 The system shall be equipped to allow the indoor unit to be powered directly from the associated outdoor unit using 3-wire, 14 gauge AWG connections plus ground.

2.4 CEILING-CONCEALED DUCTED INDOOR UNIT

A. GENERAL

01 The unit shall be a ceiling-concealed ducted indoor fan coil design that mounts above the ceiling. The unit shall be rated for installation within ceiling plenums.

02 The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. UNIT CABINET

01 The unit cabinet shall be constructed of zinc-coated steel.

02 The cabinet panel shall have provisions for a field installed filtered outside air intake.

C. FAN

01 The unit shall feature external static pressure settings from 0.14 to 0.60 in. WG.

02 The indoor unit fan shall be an assembly with one or two fan(s) direct driven by a single motor.

03 The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
04 The indoor fan shall consist of a minimum of three (3) speeds, High, Mid, and Low plus the Auto-Fan function.
05 The indoor unit shall have a ducted air outlet system and ducted return air system.

D. FILTER
01 Return air shall be filtered by means of a standard factory installed return air filter.
02 Return filter box with high-efficiency filter shall be provided for all indoor units. Filter efficiency ratings shall be as scheduled.

E. COIL
01 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
02 The tubing shall have inner grooves for high efficiency heat exchange.
03 All tube joints shall be brazed with phos-copper or silver alloy.
04 The coils shall be pressure tested at the factory.
05 A condensate pan and drain shall be provided under the coil.
06 The condensate shall be gravity drained from the fan coil.
07 Both refrigerant lines to the indoor units shall be insulated.

F. ELECTRICAL
01 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
02 The system shall be equipped to allow the indoor unit to be powered directly from the associated outdoor unit using 3-wire, 14 gauge AWG connections plus ground.

2.5 MICROPROCESSOR CONTROL

A. The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted control enclosure shall be 4.75" x 4.75" and white in color with include a light-blue LCD providing continuous display of operating status and alarm condition. There shall be a built-in weekly schedule with up to 5 scheduled event settings per day.

B. A 5-key membrane keypad for setpoint/program control, increase/decrease temperature set point, fan speed selection and unit operation mode shall be located below the display. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C), and Temperature changes shall be by increments of ±3.6°F (±2°C).

C. The control display shall be field-wired to the control board using factory-supplied thermostat wire with plugs. The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. Communication cable can be extended to a maximum of 164 feet, between controller and indoor unit.

D. The control shall be able to be programmed for a temperature set point between 64 - 86°F (18 - 30°C) with a sensitivity of ±3.6°F (±2°C).

E. The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.

F. For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed at the wall mounted controller.

G. The control system shall monitor unit operation and activate a visual alarm in the event of an alarm condition.

H. Unit controls shall be capable of interfacing the EMCS via BACnet communication protocol. If BACnet protocol is not a native communication protocol to the factory controls, then a separate gateway shall be provided as required.

2.6 OUTDOOR AIR-COOLED PROP FAN CONDENSING UNIT

A. Condensing unit components shall include a condenser coil, a brush-less digitally controlled variable propeller-type fan, an inverter driven twin rotary compressor, electronic expansion valve, 4-way reversing valve.

B. All components shall be factory-assembled, charged with R-32 or R-454B refrigerant and sealed. No internal piping, brazing, dehydration or charging shall be required.

C. The condenser coil shall be constructed of copper tubes and aluminum fins.

D. The condensing unit shall be designed to operate at a sound level less than 57 dBA.

E. The casing shall be constructed from galvanized steel plate, finished with a white electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability. Easy access shall be afforded to all serviceable parts by means of removable panel sections. The fan grill shall be constructed of polypropylene.

F. The condensing unit shall be furnished with a single DC fan motor. The fan blade shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

G. The condensing unit coil shall be of copper tubing with louvered aluminum fins. The coil shall be protected with an integral metal guard. The coil shall have an anti-corrosive coating designed to prevent natural surface corrosion of the aluminum fins, maintaining heat transfer properties of the coil and extending service life. Refrigerant flow from the condenser shall be controlled by means of an electronic expansion valve (EEV) metering device. The EEV shall be controlled by a microprocessor step motor.

H. The compressor shall be a DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used. The outdoor unit shall have an accumulator and high-pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

2.7 ACCESSORIES

A. The unit shall be provided with a wind baffle low ambient operation kit. The wind baffle shall be constructed on 20 gauge sheet metal and painted to prevent corrosion. Unit shall be able to provide 100% capacity when operating at 0ºF outdoor air temperature and a wind baffle is used.

B. The unit shall be provided with a cooling coil condensate pump. The condensate pump shall be complete with integral float switch, pump, motor assembly and reservoir.

C. The unit shall be provided with a BACnet gateway for integration with the EMCS.

D. The outdoor unit shall be provided with condenser coil hail guards.

2.8 REFRIGERANT LEAK DETECTION

A. Indoor units shall be provided with factory installed leak detection system with sufficient quantity of refrigerant detection sensors to detect refrigerant leaks throughout the equipment cabinet.

B. When the system detects a leak, the unit controller shall automatically initiate mitigation actions to prevent excessive refrigerant concentrations within occupied spaces.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR CONDITIONING UNIT

A. General
   01 Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer’s recommended clearances.
   02 Refer to specification 23 02 00 – Part 1 for anchorage requirements for roof mounted equipment.
   03 Install unit and all field mounted accessories in accordance with NFPA 90A and NFPA 90B.

B. Electrical Wiring
   01 Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to electrical contractor. Install and wire per local and national codes.

C. Piping Connections
   01 Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s piping connection diagram submittal to piping contractor.

D. Drain Water Piping
   01 Connect drain line to air conditioning unit. Unit drain shall be trapped internally.

E. Field-Supplied Pans

01 A field-supplied pan with drain shall be installed beneath indoor cooling units installed above a ceiling, in a mechanical mezzanine, or in an attic space, and below heat pumps. Drain pan shall be galvanized steel and shall slope at a minimum of 1/8” per foot to drain connection. The drain pan shall extend 3” larger on all sides than unit footprint.

02 Drain pans provided below heat pumps shall be provided with a drain line routed to the nearest drain or as indicated on plans.

03 Drain pans provided below indoor cooling units shall be provided with a condensate overflow switch or separate drain line.

a.

b. If a condensate overflow switch is provided, the overflow switch shall include the following features and adhere to the following installation and operation:

1) Condensate overflow switch features:

a UL 508 listing

b 24 volt power connection

c Plenum rated casing and wiring when installed in a plenum used for return air

2) The condensate overflow switch shall be installed in the secondary drain pan and shall shut down the entire unit when the primary drain line becomes restricted. The switch shall be adjusted as required to ensure that the switch engages prior to the drain pan overflowing. At a minimum, unit shut down shall:

a De-energize supply fan

b Close outside air damper

c Generate an alarm locally at the unit and remotely through the EMCS

3.2 FIELD QUALITY CONTROL

A. Startup air conditioning unit in accordance with manufacturer’s startup instructions. Test controls and demonstrate compliance with requirements. Provide system start-up services by manufacturer’s authorized service representative confirming all system equipment and components have been installed in accordance with the manufacturer’s written instructions. Provide formal report for engineer and owner review and approval.

END OF SECTION

SECTION 23 82 19

FAN COIL UNIT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods for HVAC shall be included as a part of this Section as though written in full in this document.

1.2 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.

1.3 REFERENCES

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. AHRI 260 (I-P) - Sound Rating of Ducted Air Moving and Conditioning Equipment; 2017.

C. AHRI 340/360 (I-P) - Standard for Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment; 2022.

D. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).

E. AHRI 430 (I-P) - Performance Rating of Central Station Air-handling Unit Supply Fans; 2020.

F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

I. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

L. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.

M. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

N. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

P. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.4 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with mechanical installations similar to that required for this project.

B. All insulation shall be listed and labeled to have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E84, UL 723 and NFPA 90A.
   01 Exception: Outdoor mechanical insulation may have a flame spread index of 75 and smoke-developed index of 150.

C. Duct and plenum insulation shall comply with minimum R-value requirements of ICC (IECC) and ASHRAE Std 90.1 I-P unless greater values are indicated otherwise in the contract documents.

D. Adhesive and other material shall comply with NFPA 90A and NFPA 90B. All adhesives and sealants used on interior of building shall comply with VOC limits prescribed by SCAQMD 1168.

E. Unit fan(s) shall comply with the maximum allowable fan motor horsepower per ICC (IECC) and ASHRAE Std 90.1 I-P.

F. Unit shall meet or exceed minimum efficiency ratings in accordance with ICC (IECC) and ASHRAE Std 90.1 I-P per testing standards prescribed by AHRI 210/240 or AHRI 340/360 (I-P).

G. Units shall be tested and certified with AHRI 430 (I-P) and AHRI 260 (I-P).

H. All coils shall be constructed to meet the requirements of AHRI 410.

1.5 WARRANTY

A. Provide entire unit with parts and labor warranty by the equipment manufacturer for one year from start-up or 18 months from date received on site.

B. For units with DX coils, provide all components of the refrigeration circuit with parts and labor warranty by the equipment manufacturer for five years.

1.6 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier

B. JCI/York

C. Trane

D. AAON

E. Daikin

F. Oxygen8

2.2 GENERAL

A. Fan coil units shall be factory built, manufactured as scheduled on Drawings. Contractor shall field verify exact clearances required for fan coil units. Units shall be field located as required and shop drawings shall indicate final location for approval by Architect/Engineer.

B. Furnish and install fan coil units of the type, capacities, ratings and drive motor horsepower shown on the Drawings.

2.3 CASING

A. Unit casing shall be constructed of minimum 18-gauge galvanized steel, able to withstand a 125 hour salt spray test per ASTM B117. Unit shall have access panels on each side constructed of minimum 18-gauge galvanized steel.

B. Unit casing shall be insulated with single wall, 1 inch thick, foil-faced fiberglass insulation with a minimum rating of R-4 and shall be rated for a maximum air velocity of 5,000 feet per minute.

C. All access panels shall be fully insulated and attached with fasteners. No piping or conduit shall pass through any access panel.

D. All units shall be provided with hanger rod holes in top and bottom panels for suspension installations.

2.4 DRAIN PAN

A. All units shall be provided with one-piece stainless steel drain pan with welded corner construction. Drain pan shall be insulated with closed cell foam insulation.

B. For units installed above a ceiling, in a mechanical mezzanine, or in an attic space, provide secondary drain pan. Drain pan shall be galvanized steel and shall slope at a minimum of 1/8” per foot to drain connection. The drain pan shall extend 3” larger on all sides than unit footprint. The secondary drain pan shall be provided with a condensate overflow switch or separate drain line.

2.5 DIRECT EXPANSION COIL

A. Direct expansion coils shall be furnished with a brass distributor with solder type connections, Suction and discharge connections shall be on the same end regardless of row depth. Coils shall have intertwined circuits for equal operation on each circuit. Provide the number of distributors equal to the number of refrigerant circuits to the associated condensing unit. Refrigerant piping connections shall be clearly labeled on outside of unit.

B. Direct expansion coils shall be selected to match the saturated suction temperature and capacity of the associated condensing unit.

C. Maximum face velocity across cooling coil shall be 500 FPM, unless noted otherwise on equipment schedule.

2.6 ELECTRIC HEATING COIL

A. The unit manufacturer shall furnish an electric resistance heating assembly with heating capacity, voltage and stages as scheduled. The heater assembly shall be factory wired and installed with over temperature protection.

B. The heater assembly shall be designed and rated for installation in a blow through configuration.

C. The heater assembly shall be furnished with an incoming power distribution block capable of accepting at least 125% of the calculated current load.

D. The heater assembly shall be listed for zero clearance meeting all NFPA 70 requirements and shall be cETL listed in compliance with UL 1995.

2.7 FAN AND MOTOR ASSEMBLY

A. Units shall be furnished with double inlet, forward curved centrifugal blower that shall be statically and dynamically balanced as an assembly.

B. Fan and motor assembly shall be in a direct drive, draw-through configuration. Belt drive units are not acceptable.

C. Fan motors shall be electronically commutated with thermal overload protection and constant torque operation. The motor shall be programmed in the factory to meet the specified airflow value.

D. Fan motors shall be permanently lubricated and sealed bearings and shall operate on single or three phase power.

E. Fan motors shall be installed, factory programmed and wired to the control panel. Motor wiring shall be terminated in a junction box external to unit casing.

F. Fan motors shall be internally isolated from unit casing.

2.8 FILTERS

A. All units shall be furnished with a flat filter rack with hinged access on both sides designed for a 2” nominal standard sized filter.

B. Factory shall provide one complete set of spare throwaway filters for each unit.

C. Refer to 23 41 00 - Air Filters for additional information.

2.9 MIXING PLENUM

A. Mixing plenum shall be field fabricated and insulated as shown on drawings.

2.10 CONTROLS

A. The unit fan motor shall be completely factory wired to an external electrical enclosure. An external main incoming power non-fused disconnect switch shall be factory furnished and wired by the unit manufacturer for single point power connection.

B. Each unit shall include a 24 VAC control circuit transformer, motor control board, motor circuit fusing and terminal strip for connection of field wiring.

C. The unit shall be factory run tested and end devices shall be factory wired to terminal strip and tested for wiring continuity.

D. Each unit shall include a low voltage fan speed control device.

2.11 REFRIGERANT LEAK DETECTION

A. Units provided with DX cooling coils shall be provided with factory installed leak detection system with sufficient quantity of refrigerant detection sensors to detect refrigerant leaks throughout the equipment cabinet.

B. When the system detects a leak, the unit controller shall automatically initiate mitigation actions to prevent excessive refrigerant concentrations within occupied spaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All HVAC equipment shall be installed as per manufacturer's printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated on the Drawings or in the Specifications. Provide all items required as per manufacturer’s requirements.

C. Locations of equipment shown on the drawings are approximate. Locate units so that they may be adequately serviced and maintained.

D. During construction, provide temporary closures of taped polyethylene on openings to prevent construction dust and debris from entering unit.

E. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fans have been test run under observation.

F. Set each unit level and straight.

G. Remove all shipping blocks and restraints.

H. Make condensate drain connection. Verify that drain is properly trapped, vented and sloped to condensate termination location as shown on the drawings.

I. Make duct connections using flexible connectors. Verify that duct is independently and adequately supported.

J. The secondary drain pan shall be provided with a condensate overflow switch or separate drain line.

01 If a drain line is provided it shall be minimum of 3/4 inch and shall be routed to a visible location approved by the Architect. If this termination point is in a finished ceiling, provide an escutcheon in trim and extend pipe to 1 inch below ceiling and paint to match ceiling color.

02 If a condensate overflow switch is provided, the overflow switch shall include the following features and adhere to the following installation and operation:

a. Condensate overflow switch features:

1) UL 508 listing
2) 24 volt power connection
3) Plenum rated casing and wiring when installed in a plenum used for return air

b. The condensate overflow switch shall be installed in the secondary drain pan and shall shut down the entire unit when the primary drain line becomes restricted. The switch shall be adjusted as required to ensure that the switch engages prior to the drain pan overflowing. At a minimum, unit shut down shall:

1) De-energize supply fan(s)
2) De-energize heater(s)
3) De-energize refrigeration circuit(s) for units with DX coils
4) Close chilled water valves for units with chilled water coils
5) Close heating hot water valves for units with hot water coils
6) Close outside air and economizer dampers
7) Generate an alarm locally at the unit and remotely through the EMCS

3.2 MANUFACTURER START-UP SERVICES

A. Provide authorized representative of the manufacturer to inspect the assembly and installation of each unit. No start-up, testing or adjusting may be performed until the representative has determined that the unit has been properly installed.

B. The representative shall start-up, test and adjust units. The representative shall perform operational checks to make certain that all equipment and controls of the systems are operating properly. If defects or improper adjustments are found, they shall be corrected and tested again.

C. The representative shall prepare and provide a written start-up report to include any measurements taken, test results obtained or corrective actions required.

D. If unit has packaged controls, the manufacturer's representative shall attend a separate meeting on-site with the EMCS contractor to coordinate and execute programming between the packaged equipment controls and the EMCS.

END OF SECTION

SECTION 26 02 00

BASIC MATERIALS AND METHODS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning electrical system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronic's Engineers (IEEE).

G. American National Standards Institute (ANSI).

H. National Fire Protection Association (NFPA).

I. International Energy Conservation Code (IECC).

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

01 Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

02 Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:

01 A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.

02 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.

03 Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

01 A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

02 An index page with a listing of all data included in the Submittal.

03 A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

04 Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

05 Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

06 Identification of each item of material or equipment matching that indicated on the Drawings.

07 Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

08 Additional information as required in other Sections of this Division.

09 Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

01 REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

02 REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

03 NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

04 REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

05 CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

06 MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Provide detailed shop drawings, descriptive literature, table of contents listing all items being submitted at the beginning of each submittal package, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

01 Switchboards
02 Distribution Panelboards
03 Panelboards
04 Wiring Gutters

05 Heavy Duty Disconnect Switches
06 Lighting Fixtures
07 Lighting Contactors
08 Time Clocks
09 Lighting Control System
10 Photocells
11 Wiring Devices and Plates
12 Conduit and Fittings
13 Wire
14 General Purpose Dry Type Transformers
15 Harmonic Mitigating Type Transformers
16 Emergency Generator
17 Automatic Transfer Switches
18 Sound Reinforcing System
19 Fire Alarm System
20 Surge Protection Devices (SPD)
21 Lightning Protection

I. Refer to each specification section for additional requirements.

1.13 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
01 Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
02 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
03 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
04 Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
01 Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
a. Wall and type locations.
b. Clearances for installing and maintaining insulation.
c. Locations of light fixtures and sprinkler heads.
d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
e. Equipment connections and support details.
f. Exterior wall and foundation penetrations.
g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.
j. Valve stem movement.

k. Structural floor, wall and roof opening sizes and details.

02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 26.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

E. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

F. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____

(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____

(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow 1/4” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and ed for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26, include the following information for equipment items:
   01 Identifying names, name tags designations and locations for all equipment.
   02 Fault Current calculations and Coordination Study.
   03 Reviewed shop drawing submittals with exceptions noted compliance letter.
   04 Fabrication drawings.

05 Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.

06 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

07 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.

08 Equipment name plate data.

09 Wiring diagrams.

10 Exploded parts views and parts lists for all equipment and devices.

11 Color coding charts for all painted equipment and conduit.

12 Location and listing of all spare parts and special keys and tools furnished to the Owner.

13 Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

01 It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

02 If the client, Architect or Owner of the project requires electronic media for “record purposes”, then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD’s. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

03 At the Architect/Owner’s request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a “.rvt” or “.dwg” format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

01 Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.

02 Alternate equipment must be equal from the standpoint of materials, construction and performance.

03 Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 PRODUCT LISTING

A. Products used on this project shall be listed by Underwriters' Laboratories.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

01 Plaster Surfaces: Milcor Style K.

02 Ceramic Tile Surfaces: Milcor Style M.

03 Drywall Surfaces: Milcor Style DW.

04 Install panels only in locations approved by the Architect.

2.4 EQUIPMENT PADS

A. Provide 4-inch-high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inch beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

B. Provide 6-inch-high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inch beyond the equipment. Provide a 4-foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise.

C. Provide a minimum 6-inch-high, steel reinforced concrete pad for generators. Pads shall be sized 6” larger that the outside perimeter dimensions. Provide a 4-foot monolithic extension to the pad around the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.). Refer to structural details. Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4" radius, unless shown otherwise. The generator shall be bolted to the concrete pad per the manufacturers details.

D. Provide steel reinforced concrete pad for utility transformers. Pads shall comply with Utility Company Standards.

2.5 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.6 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.7 PAINTING

A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.8 ELECTRICAL SYSTEM IDENTIFICATION

A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Indicate voltage for that raceway. Locate markers at ends of conduit runs, on pull boxes, on junction boxes, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors, or enters non-accessible construction and at spacings of not more than 50 feet along each run of conduit. Switch-leg conduit and short branches for power connections do not have to be marked, except where conduit is larger than ¾ inch. Branch circuit conduits, junction boxes and pull boxes shall be marked with a permanent marker indicating panel name and branch circuit numbers.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. Identification of Equipment:

01 All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way. Provide black back plate with white letters and numbers for normal equipment. Provide red back plate with white letters and numbers for optional emergency equipment. Provide yellow back plate with white letters and numbers for Life safety equipment.

02 A black-white-black laminated plastic engraved identifying nameplate shall be secured by stainless steel screws to each automatic transfer switch, switchboard, distribution panel, motor control center, motor starter panels and panelboards.

a. Identifying nameplates shall have ¼ inch high engraved letters and shall contain the following information:
   1) Name
   2) Voltage
   3) Phase
   4) "3" or "4" wire, and
   5) Where it is fed from.

b. An example of a panelboard nameplate is:
   Center Panel – 1HB
   480/277 volt, 3 phase, 4 wire
   Center Fed from DP2

c. An example of an automatic transfer switch nameplate is:
   Center ATS #2
   480/277 volt, 3 phase, 4 wire, 4 pole
   Center Fed from MSB and DPE

03 Each feeder device in a switchboard, distribution panel, and motor control center device shall have a nameplate showing the load served in ½ inch high engraved letters.

04 A black-white-black laminated plastic engraved identifying nameplate shall be secured by screws to each transformer, safety switch, disconnect switch, individual motor starter, enclosed circuit breaker, wireway, and terminal cabinet.

a. Identifying nameplates shall have 1/4 inch high engraved letters and shall indicate the equipment served.

b. An example of a disconnect switch is: AHU-1.

05 Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters' Laboratories, Inc.), and approval labels are exceptions to this requirement.

06 Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

07 Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING."

D. Identification of Wiring Devices

01 Contractor shall indicate the circuit serving each wiring device. Provide a typewritten label located on the inside face of the coverplate for all recessed mounted devices and on the outside face of the coverplate on all surface mounted devices.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:

01 Where shown to be exposed.

02 Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. Contractor shall install underground raceways including but not limited to feeders, service laterals, branch circuit and telecommunications. Contractor shall saw cut existing hard surfaces, when required for installation. Contractor shall patch surface to match existing conditions. Contractor shall replace all landscaping material when raceways are installed in these areas. Submit proposed method for patching for review.

C. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

D. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by "3M" or approved equal.

E. Refer to 26 05 33 for additional requirements.

3.4 ELECTRICAL GEAR

A. Install all electrical equipment in accordance with the National Electrical Code and as shown on the drawings.

B. Lighting contactors, time clocks, fire alarm equipment, security equipment disconnect switches, etc. mounted in mechanical/electrical rooms shall be mounted at a working height not requiring a ladder, when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

C. Fire retardant back boards secured to drywall studs may be used for contactors, time clocks, fire alarm equipment, security equipment, and disconnect switches 60 amp or smaller. All other wall mounted devices shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

3.5 CLEANING

A. Clean lighting fixtures and equipment.

B. Touch-up and refinish scratches and marred surfaces on panels, switches, starters, and transformers.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

01 At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.

02 Panelboards, switches, fixtures, etc., shall be cleaned and in operating condition.

03 Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.

04 Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.

05 After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

F. The contractor shall provide a thermographic test using an independent testing laboratory using an infrared scanning device. This test shall include but not limited to all switchboards, distribution panelboards, panelboards, automatic transfer switches and other electrical distribution devices. This test shall be conducted to locate high temperature levels. This test shall be conducted between 3 to 8 months after occupancy, but not beyond the one year warranty period. Submit test to the architect and engineer using test reporting forms. All unacceptable conditions shall be corrected prior to the end of the warranty period.

END OF SECTION

SECTION 26 02 01

COORDINATION DRAWINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions 01 31 00 and Supplementary Conditions apply to all Work herein.

1.2 COORDINATION DRAWINGS

A. The Contractor shall take the lead in coordinating the Mechanical, Electrical, Plumbing, Communications, Electronic Safety/Security and Fire Protection systems within the building.

B. The Contractor shall coordinate a three-dimensional (3D) model of the building which includes the Mechanical, Electrical, Plumbing, and Fire Protection systems. The Mechanical, Electrical, Plumbing, and Fire Protection Contractors shall prepare their work and generate 3D models which will be given to the Contractor for coordination. The Contractor will be provided with the REVIT model that was used to generate the contract documents, this file may be used as the background file. The Contractor shall replace the systems drawn with the actual shop drawing models. The Contractor is not limited to using REVIT, but may use any 3-D software in generating and combining the coordination model.

C. Submitting the contract drawings as coordination drawings will not be acceptable.

D. The model shall include detailed and accurate representations of all equipment to be installed based upon the reviewed equipment submittals.

E. The Contractor shall hold a 3-D coordination meeting with all sub-contractors present to review the model and discuss coordination of the installation of the building systems.

F. Upon completion of the coordination meeting, the Contractor shall submit the 3-D model and 1/4" scale drawings for review.

G. The model shall detail major elements, components, and systems in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

01 Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

a. Wall and type locations.
b. Clearances for installing and maintaining insulation.
c. Locations of light fixtures and sprinkler heads.
d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
e. Equipment connections and support details.
f. Exterior wall and foundation penetrations.

g. Routing of storm and sanitary sewer piping.
h. Fire-rated wall and floor penetrations.
i. Sizes and location of required concrete pads and bases.
j. Valve stem movement.
k. Structural floor, wall and roof opening sizes and details.

02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

H. Sequence of Coordination

01 Below is hierarchy of model elements and the sequencing by which the models will be coordinated:

a. Structural and Architectural model
b. Miscellaneous steel
c. Perform preliminary space allocation
d. Identify hard constraints (locations of access panels, lights, A/V space requirements, etc.)
e. Main and medium pressure ducts from the shaft out
f. Main graded plumbing lines and vents
g. Sprinkler mains and branches
h. Cold and hot water mains and branches
i. Lighting fixtures and plumbing fixtures
j. Smaller sized ducts and flex ducts
k. Smaller size cold water and hot water piping, flex ducts, etc.

I. The Contractor shall not install any item until the coordination has been completed and reviewed by the Construction Manager, Owner, and A/E team.

J. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

K. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

END OF SECTION

SECTION 26 05 19

WIRE, CABLE AND RELATED MATERIALS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 600 volt building wire, cable and connectors and 300 volt wire, cable and connectors.

B. WORK INCLUDED: Include the following Work in addition to items normally part of this Section.
   01 Wiring for lighting, dimming controls and power.
   02 Automatic Control Wiring.
   03 Connection of equipment shown.
   04 Fire Alarm System.

C. WORK SPECIFIED ELSEWHERE:
   01 Heating, ventilating, and air conditioning equipment.
   02 Structured cabling system.
   03 Coaxial cables

1.2 REFERENCE STANDARDS

A. UL 4 - Armored Cable

B. UL 83 - Thermoplastic-Insulated Wires and Cables

C. UL 1063 - Standard for Machine-Tool Wires and Cables

D. UL 1569 - Metal-Clad Cables

E. UL 1685 - Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

F. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire

G. NFPA 70 - National Electrical Code

H. All wire cable and connectors shall be UL approved.

I. NEMA

J. NEMA Bulletin 119

1.3 ACCEPTABLE MANUFACTURERS

A. 600 VOLT WIRE AND CABLE
   01 Southwire
   02 Encore
   03 Cerro
   04 Atkore

B. 300 VOLT WIRE AND CABLE
   01 Westpenn
   02 Beldon
   03 Alpha
   04 Tappan - Southwire

C. FLEXIBLE CABLE SYSTEMS
   01 AFC Modular Cable Systems
   02 Kaf-Tech

D. CONNECTORS
   01 Ilsco
   02 Cooper
   03 AMP - TYCO
   04 Burndy
   05 Ideal
   06 3M
   07 O.Z. Gedney
   08 Thomas & Betts
   09 Buchanan

1.4 SUBMITTALS

A. Shop drawings shall include, but not limited to:
   01 Cutsheets of wire, cable and connectors to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:

A. National Electrical Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 WIRING

A. All wire shall be new and continuous without weld, splice, or joints throughout its length. It must be uniform in cross-section, free from flaws, scales and other imperfections.

B. WIRE MATERIAL: Conductors shall be soft drawn, annealed copper. Aluminum wiring is not acceptable unless otherwise noted on drawings.

C. TYPES:
   01 Provide type “THHN/THWN-2” insulation for all buried feeders and service entrance conductors.
   02 Provide type “THHN/THWN-2” insulation for all branch circuits and above grade feeders.
   03 All wire No. 8 and larger shall be stranded. All wire No. 10 and smaller shall be stranded or solid.
   04 Provide type "XHHW" or other 90 degrees insulation wiring for branch circuit wiring installed through continuous rows of fixture bodies.
   05 All 300-volt cable including but not limited to telephone, fire alarm, data, CATV and security shall be UL listed for use in return air plenums.

06 All dimming conductors shall be 300 volt, 75 C plenum rated. Dimming conductors shall be solid. Stranded conductors are not acceptable.

D. CONDUCTOR SIZES

01 Feeder conductors shall be sized for a maximum of 2% drop in rated voltage at scheduled load.

02 Branch circuit conductors shall be sized for a maximum 3% drop in the rated voltage to the longest outlet on the circuit.

03 Minimum wire shall be 12 AWG, unless otherwise shown on Drawings or required by Code.

04 Minimum wire size for 0-10v dimming controls shall be 18 AWG for conductors not exceeding 300 feet circuit length (one-way) and 16 AWG for those exceeding 300 feet (one-way).

E. COLOR CODING: No. 6 or larger shall use tape for color coding. No. 8 and smaller wire shall be color coded in accordance with the governing authority requirements or as follows:

<u>120/208 Volt</u>
Neutral: White
Phase A: Black
Phase B: Red
Phase C: Blue
Ground: Green

<u>277/480 Volt</u>
Neutral: Gray
Phase A: Brown
Phase B: Purple
Phase C: Yellow
Ground: Green

<u>120/240 Volt</u>
Neutral: White
Phase A: Black
Phase B: Orange
Phase C: Blue
Ground: Green

<u>0-10 Volt dimming conductors</u>
Purple (source)
Pink (common)

2.2 METAL CLAD CABLE - TYPE MC (600 VOLT)

A. Provide soft drawn solid copper conductors with type THHN/ THWN-2 insulation rated 90° C in dry locations. All conductors shall be color coded. Include a white neutral and green insulated grounding conductor. Branch circuits shall include a double sized neutral when more than one phase conductors are being utilized. The conductors shall use a binding tape with a printed legend and assembled in an interlocking steel armor raceway.

PART 3 - EXECUTION

3.1 WIRE

A. Do not pull wire into conduit until Work of an injurious nature is completed. Where two or more circuits run to a single outlet box, each circuit shall be properly tagged. Wyreze or approved equal may be used as a lubricant where necessary.

B. Splices shall be fully made up in outlet boxes with compression crimp-on type splice connectors.

C. Joints and splices will not be permitted in service entrance or in feeders. Joints in branch circuits will be permitted where branch circuits divide, and then shall consist of one through-circuit to which the branch shall be spliced. Joints shall not be left for the fixture hanger to make. Connect joints and splices with Buchanan Series "2000" solderless connectors complete with insulating caps or properly sized twist on wire nuts. “Wago” push-in connectors are not acceptable.

D. All stranded conductors shall be furnished with lugs or connectors.

E. Connectors furnished with circuit breakers or switches shall be suitable for copper wire termination.

F. “Sta-Cons” shall be used to terminate stranded conductors on all switches and receptacles.

G. Metal Clad Cable - Type MC

01 All light fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit or MC cable fixture pigtails not exceeding 8'-0". Provide #12 AWG conductors. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring installed in accessible ceiling is not permitted. Fixture whips shall not lay on ceiling tile or grid. Provide caddy clips to provide additional support.

H. All stranded #10 and small conductors shall be terminated with an approved solderless terminal if the device or light fixture does not have provisions for clamp type securing of the conductor.

I. The jacket for all travelers used on 3-way and 4-way switches shall be pink.

J. Route conductors for 480Y/277 systems in a separate raceway. Do not combine with 208Y/120 volt or 120/240 volt systems.

K. Emergency circuits shall not be routed with normal conductors.

3.2 BALANCING SYSTEM

A. The load on each distribution and lighting panel shall be balanced to within 10% by proper arrangement of branch circuits on the different phase legs. Provide written documentation showing results. Submit with O & M manuals.

3.3 LOW VOLTAGE WIRING

A. Low voltage wiring, including dimming conductors, shall be plenum rated. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.

B. Low voltage wiring shall be routed in separate raceways from power wiring systems.

C. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacturer.

E. Provide a junction box to make up all joints and splices.

F. Provide dimming conductors for all lighting circuits located in spaces with dimmer switches and theatrical lighting as indicated on the drawings and as specified.

3.4 GROUNDING

A. Permanently connect all conduit work, motors, starters, and other electrical equipment to grounding system in accordance with NFPA 70.

3.5 CABLE SUPPORTS

A. Provide cable supports in all vertical raceways in accordance with Article 300.19 of NFPA 70.

3.6 DEFECTS

A. Defects shall include, but are not to limited to, the following:
   01 Tripping circuit breakers under normal operation.
   02 Improperly connected equipment.
   03 Damaged, torn, or skinned insulation.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. WORK COMBINED WITH OTHER SECTIONS: Combine the work specified herein with the following Sections to form a single responsibility for the Work:
   01 Electrical.
   02 Basic materials and methods.

B. Provide electrical service, equipment and wiring device grounding as shown, scheduled and as specified.

C. The types of grounding include, but not limited to, the grounding bonding of all equipment devices, building steel piping, and as required by the National Electrical Code, Local Inspection Department and Power Company.

1.3 STANDARDS

A. National Electrical Code (NFPA-70)

B. Local municipal and State codes that have jurisdiction.

C. NECA

1.4 ACCEPTABLE MANUFACTURES

A. Provide grounding products manufactured by Copperweld and Cadweld.

1.5 SUBMITTALS

A. Shop drawings shall include, but not limited to the following:
   01 Cut sheets of ground rods, clamps and connectors.
   02 Grounding system diagram.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all materials required to construct a complete grounded electrical system.

B. GROUND RODS: Ground rods shall be 3/4" inch diameter by 10 feet long construction with copper jacket and a steel core.

C. CLAMPS: Ground clamps shall be copper except for steel or iron pipes in which the clamps shall be galvanized iron.

D. CONDUCTORS: Conductors shall be connected by means of an approved pressure connector or clamp.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Install grounding system as shown and specified to ensure a properly grounded system.

B. SERVICE ENTRANCE GROUNDING SYSTEM: Provide a main bonding jumper between the neutral and ground bus at service entrance disconnect. Route a separate grounding electrode conductor in conduit from each main distribution panel to the ground rod grid, incoming cold water piping system, and to the "lightning protection system" (250 - 106 of NEC) under ground bonding loop. Provide a bonding jumper around water meter. The grounding electrode conductor shall be stranded copper, 98% conductivity and shall be run continuous without splices or joints and installed at least 12" below grade.

C. BUILDING STEEL AND PIPING SYSTEM: Install a bonding jumper between building steel and metallic piping systems to bond them to the electrical grounding system.

D. NEUTRAL: The neutral shall be grounded only at the service entrance and other separately derived systems. The neutral shall be kept separate from the grounding system and shall not be used as a ground.

E. GROUNDING SEPARATELY DERIVED ALTERNATING CURRENT SYSTEM
   01 TRANSFORMERS: The center point (neutral) of each wye connected transformer shall be bonded to the case and the grounding electrode conductor shall be connected to the grounded conductor (neutral).
   02 STANDBY EMERGENCY GENERATOR: The generator neutral shall be bonded to the generator when a 4-pole switched neutral automatic transfer switch is specified.

F. GROUNDING CONDUCTOR: A grounding conductor and metallic conduit system shall bond all equipment served by the electrical system. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.

G. CONDUIT GROUNDING BUSHING: Conduit terminating in equipment that has a ground bus such as switchboards, panelboards, etc., shall have grounding bushings installed. Ground each conduit by means of a grounding bushing and to the ground bus in the equipment.

H. MOTORS: The frame of all motors shall be grounded.

I. SPECIAL GROUNDING: Provide a #6 AWG copper grounding conductor for each telephone board, television system, etc. Terminate the grounding conductor on ground bus and to the building electrical grounding system. Refer to 800-40(d) and 820-40(d) of the NEC.

J. REMOTE PANELBOARDS: Provide a grounding electrode conductor all remote panels as required by the NEC and shown on drawings.

K. LIGHTING FIXTURES: Flexible fixture whips containing a green grounding conductor shall be used to connect light fixtures. Flexible fixture whips shall not exceed ten feet.

L. RECEPTACLES: All receptacles shall be grounded using the branch circuit grounding conductor. Receptacles shall use an approved grounding yoke.

M. POLES SUPPORTING OUTDOOR LIGHTING FIXTURES: Provide grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.2 TESTING

A. Perform a ground resistance test using a biddle analog or digital portable earth/ground resistance tester. The system resistance shall not exceed 5 Ohms. Provide additional electrodes as required (refer to 250-84 and 250-56 of the most current edition NEC). Test shall not be conducted following wet weather. Provide personal instruments to conduct these tests and submit certified test for review. Test shall be verified by Engineer.

END OF SECTION

SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical raceways and fittings as shown, scheduled and specified.

B. The types of raceways and fittings required are as follows:
   01 Rigid hot-dipped galvanized steel conduit (GRC) (RMC)
   02 Intermediate hot-dipped galvanized steel conduit (IMC)
   03 Electrical metallic tubing (EMT)
   04 PVC (Sch. 40 & 80)
   05 Flexible metal conduit (FMC)
   06 Liquid-tight flexible metal conduit (LFMC)
   07 PVC coated rigid galvanized steel conduit (GRCC)
   08 Rigid Aluminum Conduit (RAC)

1.2 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

F. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

G. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

H. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

I. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

J. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

K. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

L. NEMA FB-1

M. NEMA TC3

1.3 ACCEPTABLE MANUFACTURERS

A. Raceways
   01 Allied
   02 Republic
   03 Prime Conduit (Carlon)
   04 Wheatland Tube
   05 Cantex
   06 Western Tube
   07 Robroy Industries

B. Fittings
   01 Appleton
   02 Crouse Hinds
   03 Steel City
   04 O.Z. Gedney
   05 Carlon
   06 Raco, Inc.
   07 Bridgeport

C. Boxes
   01 RACO
   02 Thomas and Betts
   03 EATON
   04 Crouse-Hinds
   05 Appleton

D. Surface
   01 Hubbell
   02 Wiremold

1.4 SUBMITTALS

A. Product data shall include but not be limited to:
   01 Cutsheets for raceways, fitting, solvents, primers, etc.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH

A. NFPA 70

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Rigid Galvanized Steel Conduit (GRC/RMC)
   01 Construction, Materials, Codes, Standards:
      a. Article 344 - NFPA 70.
      b. Hot-dip galvanized rigid steel conduit, galvanized after fabrication. Products shall comply with UL 6 and ANSI C80.1. All threads shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls.
      c. Fittings shall be threaded and shipped with thread protectors. Set Screw are not acceptable. Die Cast Fittings are not acceptable.

02 Permitted for use in the following locations:
   a. Outdoor or Exterior (Exposed)
   b. Indoors, Conditioned Spaces
   c. Unconditioned Spaces
   d. Underslab (Void Form Slab): where not in contact with earth – only permitted where indicated on plan.
   e. Underslab (Suspended Slab): Permitted – only where indicated on plan.
03 Prohibited Locations: Underground, Corrosive environments, Underslab (Slab on Grade), Foundation penetrations.
04 Specific Uses: Exposed Exterior installations, where within or attached to masonry or concrete, where subject to damage.

B. Intermediate Metal Conduit (IMC)
01 Construction, Materials, Codes, Standards:
   a. Article 342 - NFPA 70.
   b. Conduit shall be similar to rigid steel conduit except thinner wall.
   c. Fittings shall be threaded hot-dipped galvanized and shipped with thread protectors. Set Screw or Die Cast Fittings are not acceptable
   d. Products shall comply with UL 1242.
02 Permitted for use in the following locations:
   a. Outdoor or Exterior (Exposed)
   b. Indoors, Conditioned Spaces
   c. Unconditioned Spaces
   d. Underslab (Void Form Slab): not in contact with earth only as indicated on plan.
   e. Underslab (Suspended Slab): only where indicated on plan.
03 Prohibited Locations: Corrosive Environment, Underground, Underslab (Slab on Grade), Foundation Penetrations
04 Specific Uses: Exposed exterior locations, Rooftops exposed to sunlight

C. Electrical Metallic Tubing (EMT)
01 Construction, Materials, Codes, Standards:
   a. Article 358 - NFPA 70.
   b. EMT shall be made of hot-dip galvanized strip steel. The interior shall be coated with a corrosion-resistant lubricant for ease of wiring pulling.
   c. Shall utilize steel insulated throat, set-screw connectors and steel set-screw couplings in all indoor conditioned spaces.
   d. Shall utilize steel insulated throat, threadless, watertight compression type connectors and steel threadless watertight compression type coupling in all non-conditioned spaces and in grout filled CMU walls.
   e. Products shall comply with UL 797 and ANSI C80.3.
02 Permitted for use in the following locations:
   a. Indoors, Conditioned Spaces
   b. Unconditioned Spaces
03 Prohibited Locations: Corrosive Environment, Underground, Underslab (all types), Wet or Damp Locations, Exteriors, Within Concrete, foundation penetrations.
04 Specific Uses: Primary use conduit for indoor spaces, where conditioned. Unconditioned locations shall require use of insulated throat water tight fittings.

D. Rigid Nonmetallic Conduit (PVC Schedule 40 & 80)
01 Construction, Materials, Codes, Standards:
   a. Article 352 and 300.6 - NFPA 70.
   b. Conduit shall be schedule 40 or 80 polyvinyl chloride (PVC), UV stabilized, rated for 90°C conductors.
   c. Fittings shall be solvent weld socket type.
   d. Products shall comply with UL 651.

02 Permitted for use in the following locations:
a. Underground (Earth, outside foundation perimeter)
b. Underslab (Slab on Grade): only where indicated on plan.
c. Under Driveways, roadways, or vehicular crossings, and where required by Utility Company: PVC Schedule 80
1) PVC Schedule 40 allowed where concrete encased.
03 Prohibited Locations: return air Plenums, interstitial spaces, Outdoor or Exterior (Exposed), Unconditioned spaces, corrosive environments, underslab (suspended or void form), foundation penetrations.
04 Specific Uses: For use underground or underslab (Slab on grade). Underground use is approved for all locations where transiting a project site, not underneath any foundation. For locations under the footprint of building/foundation, use only authorized where indicated on drawings.

E. Flexible Metal Conduit (FMC/Greenfield)
01 Construction, Materials, Codes, Standards:
a. Article 348 - NFPA 70.
b. Spirally wound continuously interlocked zinc coated strip steel.
c. Fittings shall be one screw for smaller than 1-1/2-inch, two screw for 1-1/2-inch and larger, double clamp steel or malleable iron, either cadmium plated or hot-dip galvanized.
d. Products shall comply with UL 360.
02 Permitted for use in the following locations:
a. Indoors, Conditioned Spaces.
03 Prohibited Locations: outdoors/Exterior, unconditioned spaces, Corrosive, Wet, Concrete, underslab(all types), underground, foundation penetrations.
04 Specific Uses and Applications: For use in connection to rotating equipment within conditioned spaces, including plenums. Also permitted for use with empty raceways in walls for use with Low Voltage, AV, telecom cabling.

F. Liquid-Tight Flexible Steel Conduit (LFMC/Seal Tite)
01 Construction, Materials, Codes, Standards
a. Article 350 - NFPA 70.
b. Spirally wound continuously interlocked zinc coated strip steel with a UV stabilized polyvinyl chloride (PVC) outer jacket bonded to the conduit.
c. Fittings shall be compression type, malleable iron, with insulated throat, either cadmium plated or hot-dip galvanized. Plastic is not acceptable.
02 Permitted for use in the following locations:
a. Outdoor or Exterior (Exposed)
b. Indoors, Conditioned Spaces
c. Unconditioned Spaces
03 Prohibited Locations: Concrete, corrosive, underground, underslab (all types), foundation penetrations.
04 Specific Uses and Applications: Primary use is connection to rotating equipment at unconditioned spaces. Transformer Primaries and Secondaries (excluding service transformer).

G. PVC Coated Rigid Galvanized Steel Conduit (GRCC/Plastibond)
01 Construction, Materials, Codes, Standards:
a. Article 344 and 300.6 - NFPA 70.
b. Conduit shall be same as rigid metal conduit with a factory-applied 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the metal, coated inside and outside.
02 Permitted for use in the following locations:
a. Outdoor or Exterior (Exposed): except for stub-ups and penetrations.
b. Corrosive Environment: required throughout

1) Where corrosive environments exist, such as pools, pool pump room, corrosive chemical storage, GRCC shall be provided throughout, up to the point of sealed penetration into a non-corrosive environment.

c. Underground (Earth, outside foundation perimeter): Required at bends of 15° or greater, Penetrations through concrete, Stub-ups through foundation or grade at concrete.

d. Foundation Penetrations

03 Prohibited Locations: extended runs exposed to sunlight, Plenums, Underslab except for penetrations (all foundation types).

04 Specific Uses: For use at Cooling Towers, Natatoriums, Pools, Pool Decks, Pool pump rooms, chemical storage, corrosive environments.

H. Rigid Aluminum Conduit (RAC)

01 Construction, Materials, Codes, Standards:

a. Article 344 - NFPA 70.

b. Rigid aluminum (alloy 6063-T1) conduit shall be manufactured using 6063 Alloy in temper designation T-1.

c. Fittings for rigid aluminum conduit shall be threaded aluminum shipped with thread protectors. Set Screw or Die Cast Fittings are not acceptable

d. Products shall comply with UL 6A and ANSI C80.5.

02 Permitted for use in the following locations:

a. Outdoor or Exterior (Exposed)

b. Indoors, Conditioned Spaces

c. Unconditioned Spaces

03 Prohibited Locations: Corrosive environments, underground, within concrete, underslab (all types), foundation penetrations.

04 Specific Uses and Applications: Exposed Exterior such as rooftops or canopies.

2.2 PULL BOXES

A. Exterior in-ground pull boxes shall be concrete or polymer as manufactured by Brooks, Dalworth, Hubbell Quazite, or approved equivalent. Covers shall include identification of systems contained.

B. Where located in Roadways, Parking Lots, or Traffic zones, Pullboxes shall be rated to accept a minimum 22,500 lb. load per ANSI/SCTE 77.

C. All Pullboxes shall be sized based on NEC wire-bending requirements at each individual location.

D. Covers shall include identification of systems contained, such as:

01 Electrical

02 Telecom

03 Communications

04 Others, as required.

E. Pull boxes in pole bases shall be as manufactured by Carlon.

F. Pullboxes shall be provided in all raceway systems upon exceeding the following conditions:

01 The equivalent of 270° in conduit bends, or after (3) 90° bends.

02 Any 400ft of linear conduit or duct bank continuous segments.

03 Where required to make transitions to prevent the damaging of conductor insulation.

2.3 WIREWAYS

A. Wireways shall be made of not less than 16-gauge sheet steel for 4 inch and 6 inch square sizes and 14 gauge steel for 8 inch and 12 inch square sizes. Couplings end plates, and knockouts shall be furnished as required. Each section of wireways shall be rigidly supported.

B. The finish shall be ANSI-49 gray epoxy paint applied by a cathodic electrode position paint process over a corrosion resistant phosphate preparation for NEMA 1 wireways. Provide galvanized steel for NEMA 3R wireways. NEMA 3R wireways and auxiliary gutters are for horizontal mounting only.

2.4 BUSHINGS

A. Provide nylon bushing on end of all low voltage cabling system conduits (sleeves, rough-ins, etc.).

B. Provide Grounding Bushing as required in 26 05 26 - Grounding.

PART 3 - EXECUTION

3.1 PROVIDE CONDUIT AS FOLLOWS:

A. GENERAL: The Drawings are diagrammatic and are intended to show the general location of outlets, devices, fixtures, and arrangement and control of circuits. The Contractor shall determine exact locations by actual measurement of the building or by reference to the Architectural Drawings.

B. All wiring shall be installed in galvanized rigid steel, rigid aluminum conduit or electrical steel tube (EMT) unless otherwise noted or specified. Each raceway shall be sized to contain the number of conductors required to comply with the latest edition of NFPA 70. Conduit sizes that are scheduled or shown on the drawings shall take preference.

C. Raceways shall not be routed below or within slab-on-grade, foundations, or below grade of suspended slab structures, unless specifically noted or indicated otherwise on plan.

D. EMT in sizes up to 4 inches when concealed or not exposed to damage and located indoors only. (EMT is not acceptable in wet and damp location.)

E. MINIMUM SIZE: 3/4 inch.

F. Flexible conduit of any type shall not be used except for connections to rotating or vibrating equipment, or where use for low voltage raceways. All conduit shall be provided as a rigid type conduit for homeruns, runs between termination boxes, outlets, etc.

G. Fixture whips: Refer to 26 51 19 for additional information.

H. Of such size, and so installed that conductors may be drawn in without injury or excessive strain.

I. Where entering panels, pull boxes, junction boxes, or outlet boxes, shall be secured in place with lock nuts inside and outside, and insulated bushings inside.

J. Have Red seal type VCC or approved equal cable supports in risers, as required by NFPA 70.

K. Have ends reamed after cutting and application of die.

L. Keep conduit corked and dry during construction and swab out before conductors are pulled.

M. Have bends and offsets made with approved tools. Bends or offsets in which the pipe is crushed or deformed shall not be installed.

N. Have O.Z. Gedney or approved equal expansion fittings where crossing building expansion joints.

O. Fixtures in finished areas having suspended acoustical ceilings shall be connected to outlet boxes of lighting grid by flexible metal conduit; length not to exceed ten feet (six feet if using 3/8" manufactured fixture "whips").

P. Outlet boxes in partitions shall never be set back-to-back. They shall be offset to prevent undue noise transmission from room to room.

Q. Each entire conduit system shall be installed complete before any conductors are drawn in. Every run of conduit shall be finished before covering up to guard against obstructions and omissions.

R. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of conduits. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel with a minimum thickness of 1.07MM and set to extend 4" above slab.

S. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty. All fire rating material shall be installed in accordance with manufacturer`s printed instructions.

T. All conduit shall be cleaned and swabbed to remove all foreign matter and moisture prior to pulling wire and cable. All boxes in which conduits terminate shall be cleaned of all concrete mortar and other foreign matter.

U. Provide #30 nylon pulling line in all conduits in which permanent wiring is not installed.

V. All conduit shall be securely fastened and supported using hot galvanized malleable iron one-hole pipe straps, clamps, hanger or other means approved by the engineer. Supports shall be as required per NEC. Tie wire shall not be used as support or securing means. Support conduit independently of ceiling hanger wire. Use all thread rods to support outlet boxes, junction boxes and conduit.

W. Contact the Architect and Engineer for an installation review before covering any below grade or above grade conduit.

X. All new outlets shall be flush mounted. In remodeled areas where wall construction prohibits flush mounting, provide Hubbell 2400 series, unless noted otherwise. Verify exact location and routing with architect before installation.

Y. Contractor shall not penetrate waterproof barriers without using proper fitting to maintain barriers. This shall include exterior walls and slabs. Coordinate with Architect for proper methods.

3.2 CONDUIT ROUTING

A. Conduit shall be concealed and by using the shortest practicable route between outlets, including where located on CMU walls.

B. Conduit may be exposed in electrical and mechanical rooms, and central plants, or other industrial type facilities such as warehouses or production plants.

C. Install risers, drops, offsets to avoid ductwork and structural components. Ductwork and structural systems shall take precedence to conduit.

D. Any exposed and visible conduit shall be parallel and perpendicular based on the lines of the building (such as ceiling lines, wall blocking lines, or architectural feature lines) using structural systems to conceal conduit visibility at all opportunities.

E. Concealed conduit shall be run in as direct manner as possible, using long bends. All bend radii shall be 12x conduit diameter. Condulets in lieu of elbows where ease of installation and appearance warrant their use – confirmation with architect is required for this use.

F. Conduit shall be continuous, with no more than (4) quarter bends between terminals, cabinets, boxes, or pullboxes is acceptable. Contractor is expected to provide wireway or boxes at appropriate intervals, in accordance with NFPA 70 for wire bending space. All conduit shall be electrically continuous throughout, including across boxes and cabinets. Terminals of all conduit shall be provided with double lock nuts and bushing, or terminated on conduit hubs. Use of Running Threads prohibited.

3.3 CONDUIT CORROSION PROTECTION

A. Branch circuit conduits installed in concrete slabs on fill or grade shall be positioned in a manner to ensure complete concrete cover. In no case shall such conduits be exposed below or above the slab surfaces, or penetrate the waterproof membrane.

B. At locations where metallic conduits pass through slabs on grade or transitions below grade, PVC coated rigid galvanized conduit shall be used.

C. Conduit installed in the air gap between the water-resistant barrier and finish brick shall not exceed 2-ft. in length.

3.4 EXPANSION JOINTS

A. Install approved expansion fitting in all conduit runs in excess of 150 feet or when crossing building expansion joints.

3.5 OUTLET AND JUNCTION BOXES

A. Provide an approved galvanized outlet box with adequate volume for number of conductors installed.

B. Provide standard galvanized switch boxes of the required number of gangs. Switch boxes where conduit is exposed shall be handy boxes or approved equal.

C. Outlet boxes for receptacles shall be similar to Universal 52151 with suitable raised cover. Receptacle boxes where conduit is exposed shall be handy boxes or approved equal.

D. Weatherproof boxes shall be FS or FD. Provide these boxes in all non-conditioned areas, exterior areas and natatoriums.

E. Outdoor boxes shall be NEMA 3R, with conduit connections made by Myers Hubs.

F. See notes and details on Drawings for special box requirements.

G. Provide junction boxes required to facilitate installation of the various conduit systems. Provide support boxes required for risers, each complete with approved cable supports as described elsewhere in this Division.

H. Outlet boxes for drywall shall be standard galvanized 4" square boxes with the appropriate device cover. Secure all outlet boxes with a backing brace connected to two adjacent studs. Mounting brackets with a single ear to rest against the backing sheet rock are not acceptable.

I. Provide floor outlet fittings for telephone to match fittings for duplex floor receptacles.

J. Provide 3-1/2” deep gangable masonry boxes in all masonry wall (CMU). Steel City GW-135-G or approved equal.

K. Provide shallow 4”x4” boxes in all demountable partitions.

L. Metallic boxes located in fire rated walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when “ Wall Opening Protective Materials” (CLIV) are installed according to the requirements of their Classification. Metallic boxes shall not be installed on opposite side of walls or partitions of staggered stud construction unless “Wall Opening Protective Materials” are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

M. Junction, pull boxes, condulets, gutters, disconnects, contactors, etc., above 2-foot x 2-foot grid ceilings shall be mounted within 18-inches of ceiling grid. Above 2-foot x 4-foot grid ceiling they shall be mounted within 30-inches of ceiling grid. All junction box, pull box, gutter openings shall be side or bottom accessible.

N. Junction boxes are prohibited above drywall or plaster ceilings except for lighting; and those must be mounted directly over light fixture opening. Route power, PA, fire alarm conduits to nearest lay-in ceiling.

3.6 THRU-WALL SEALS

A. Provide O.Z. Gedney “Thru-wall” seals for all conduits passing through concrete structure below grade, above grade, and floor penetrations below grade. These prevent moisture from entering the building.

B. Straight sleeves are not acceptable.

3.7 PULL BOXES

A. Interior Pull boxes shall be provided for conduit systems as required and shall be constructed of galvanized steel of not less than gauge and size specified by National Electrical Code. Size pull boxes per Article 314.28 - NFPA 70.

B. Where two or more feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation.

C. Exterior in-ground pull boxes shall have open bottoms with sand and rock beds below box for drainage of water. Provide closed bottom boxes where specified. Closed bottom boxes shall be provided with sumps for portable pump to allow for extracting water. Refer to details on the drawings.

D. Pull boxes mounted in pole bases shall be coordinated with the pour of the pole base and shall be flush with finished footing.

3.8 WIREWAYS

A. Wireways shall be installed as indicated or required and locations shall be coordinated with architect.

B. Wiring in wireways shall be neatly bundled, tied and suitably tagged.

3.9 UNDERGROUND DUCTBANK SYSTEM

A. DUCT SYSTEM

01 The duct system shall consist of Schedule 40 PVC or type 1-EB PVC conduits encased in red concrete as detailed on the drawings. Use rigid conduit for stub-ups and the last ten feet at the end of each ductbank. Duct lines shall be laid to a minimum grade of 4 inches per 100 feet and shall be free from either horizontal or vertical waves. Duct lines shall be straight unless otherwise noted on the drawings. Duct lines shall be installed so that the top of concrete in encased duct lines is not less than 24 inches below finished grade or finished paving at any point. Changes in direction or runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5 feet. The long sweep bends may be made up of one or more curved or straight sections and/or combinations thereof using five degree angle couplings. Conduit shall be thoroughly cleaned before using or laying. During construction and after the duct line is completed, the ends of the conduit shall be plugged to prevent water washing mud into the conduits. Particular care shall be taken to keep the conduits clean of concrete, dirt, and any other substance during the course of construction.

02 Each single conduit of the duct bank shall be completely encased in steel reinforced concrete as indicated. The thickness of concrete encasement indicated is the minimum thickness, and may be increased to fit the actual shape of trench.

03 Concrete for duct bank envelopes shall be standard 2000 psi concrete mix as described in Division 03, and be colored deep red for permanent marking of underground electrical work. The concrete red pigment shall be pure inorganic natural metallic base pigment, approved by the Engineer before use. Organic pigments will not be permitted. The approved pigments shall be mixed four pounds per yard of cement.

a. Envelopes may be poured directly against sides of trenches if the "cut" is clean, even and free of loose material. All loose dirt and extraneous material shall be removed from the trenches before and during the pouring of concrete to ensure sound envelopes. Concrete shall be carefully spaded during pouring to eliminate all voids under and between the conduit and honeycombing of the exterior surfaces. Power driven tampers of agitators shall not be used, unless specifically designed for the application, in order to ensure that the water-tightness of the conduits is not destroyed.

b. Generally, each run of envelopes shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in a vertical plane. Partial pours shall not terminate in horizontal or angular planes.

B. For normal underground installation see Section 26 02 00, paragraph 3.1 for Excavating and Backfilling.

END OF SECTION

SECTION 26 05 73

SHORT CIRCUIT COORDINATION STUDY ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish short-circuit and protective device coordination studies for the electrical power system, including all existing and newly installed electrical equipment. The analysis and study shall include all distribution branches, and begin at the main overcurrent protective device.

B. Provide a complete short circuit study, equipment interrupting or withstand evaluation, and protective device coordination study for the power distribution system. Normal operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly addressed in the study. The study shall assume all motors operating at rated voltage and speed. Electrical equipment bus impedance shall be assumed as zero. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at the switchboard busses and motor control centers (where installed).

C. A protective device coordination study shall be performed to determine appropriate relay settings. The study shall include all distribution switchboards, motor control centers (where installed, and panel board main circuit breakers. Panel board branch circuit devices need not be considered. The phase over current and ground fault protection shall be included as well as setting for all other adjustable protective devices.

D. An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents.

E. Any problem areas or inadequacies shall be promptly brought to the ENGINEERS attention.

F. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Annex D.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   - 01 IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
   - 02 IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
   - 03 IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
   - 04 IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
   - 05 IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
   - 06 IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

01 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
02 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
03 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
04 ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)
01 NFPA 70 - National Electrical Code, latest edition
02 NFPA 70E - Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS FOR REVIEW/APPROVAL

A. The short-circuit and protective device coordination studies shall be submitted to the design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.

B. The report shall include the following sections:
01 One-line diagram
02 Descriptions, purpose, basis and scope of the study
03 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
04 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
05 Fault current calculations including a definition of terms and guide for interpretation of the computer printout
06 Incident energy and flash protection boundary calculations
07 Recommendations for system improvements, where needed
08 Executive Summary.
09 Equipment manufacturer’s information used to prepare study
10 Assumptions made during study.

1.5 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 - PRODUCT

2.1 DATA COLLECTION

A. The Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.

D. Include fault contribution of existing motors in the study, with motors <100 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.2 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE 141.

B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:
   01 Calculation methods and assumptions
   02 Selected base per unit quantities
   03 One-line diagram of the system being evaluated
   04 Source impedance data, including electric utility system and motor fault contribution characteristics
   05 Typical calculations
   06 Tabulations of calculated quantities
   07 Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
   01 Electric utility's supply termination point
   02 Incoming switchgear
   03 Low voltage switchgear
   04 Motor control centers
   05 Branch circuit panelboards
   06 Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:
   01 Evaluate equipment and protective devices and compare to short circuit ratings
   02 Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
   03 Adequacy of transformer windings to withstand short-circuit stresses
   04 Cable and busway sizes for ability to withstand short-circuit heating

05 Notify Owner in writing of any new or existing circuit protective devices improperly rated for the calculated available fault current.

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.

B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the curve sheets, where applicable for this project:
01 Electric utility's protective device
02 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
03 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
04 Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
05 Conductor damage curves
06 Ground fault protective devices, as applicable
07 Pertinent motor starting characteristics and motor damage points
08 Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center.

F. Provide time margins between device characteristics per the following requirements such that selective coordination is provided. Selective coordination shall be proven with a coordination study provided by the equipment manufacturer with the use of time current curves, or manufacturers' selective coordination tables, or both.
01 Emergency (NEC Article 700) - all currents, all times
02 Legally Required Stand-by (NEC Article 701) - all currents, all times
03 Elevator Systems (NEC Article 620) - all currents, all times
04 Health Care Essential Electrical Systems (NEC Article 517)
a. Equipment Branch - 0.10 seconds
b. Critical Branch - 0.10 seconds
c. Life Safety Branch - 0.10 seconds

2.4 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 75 kVA.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2.

2.5 REPORT SECTIONS

A. Input Data:
- 01 Short-circuit reactance of rotating machines
- 02 Cable and conduit materials
- 03 Transformers
- 04 Circuit resistance and reactive values.

B. Short-Circuit Data:
- 01 Source fault impedance and generator contributions
- 02 X to R ratios
- 03 Asymmetry factors
- 04 Motor contributions
- 05 Short circuit kVA
- 06 Symmetrical and asymmetrical fault currents.

C. Recommended Protective Device Settings:
- 01 Phase and Ground Relays:
  - a. Current transformer ratio
  - b. Current setting
  - c. Time setting
  - d. Instantaneous setting
  - e. Specialty non-overcurrent device settings
  - f. Recommendations on improved relaying systems, if applicable
- 02 Circuit Breakers:
  - a. Adjustable pickups and time delays (long time, short time, ground)
  - b. Adjustable time-current characteristic
  - c. Adjustable instantaneous pickup
  - d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations
- 01 Arcing fault magnitude

02 Device clearing time
03 Duration of arc
04 Arc flash boundary
05 Working distance
06 Incident energy
07 Hazard Risk Category
08 Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. The Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.2 ARC FLASH WARNING LABELS

A. The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:
01 Location designation
02 Nominal voltage
03 Flash protection boundary
04 Hazard risk category
05 Incident energy
06 Working distance
07 Engineering report number, revision number and issue date.

C. Labels shall be machine printed, with no field markings.

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
01 For each 600, 480 and applicable 208 volt panelboards, one arc flash label shall be provided.
02 For each motor control center, one arc flash label shall be provided.
03 For each low voltage switchboard, one arc flash label shall be provided.

E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

SECTION 26 06 34

LOW VOLTAGE RACEWAY SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 WORK INCLUDED

A. Provide a complete raceway system for telephone system, consisting of cabinets, conduit, junction boxes, etc. This shall include but not limited to fire alarm, access control, structured cabling, audio-video, intercommunications, sound reinforcing, intrusion detection, telephone.

1.3 WORK SPECIFIED ELSEWHERE

A. Section 26 02 00 - Basic Materials and Methods for Electrical

B. Section 26 05 33 - Raceways

C. Section 26 05 19 - Wire, Cable and Related Materials

1.4 WORK NOT INCLUDED

A. Cabling

B. Equipment

C. Division 27

D. Division 28

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Conduit - Refer to Section 26 05 33.

B. Backboards - 3/4" X 4' X 8' fire rated plywood painted white.

C. Outlet Boxes - Refer to Section 26 05 33.

D. Pull and junction boxes - Refer to Section 26 05 33.

E. Floor Boxes - Refer to Section 26 05 33.

F. Cabinets - Consult low voltage system installer/supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 26 05 33 for underground service entrance.

B. Provide pull boxes in telephone conduit runs spaced not greater than 100 ft. apart, and on backboard side of runs with more than two right angle bends.

C. Place telephone label on pull and junction boxes.

D. Provide pull wire in each telephone run.

E. Provide plywood backboards and duplex receptacle in the telephone equipment room. Confirm location on jobsite prior to installation.

F. All terminal cabinets/backboards and conduit shall be sized per the recommendations of the telephone system installer.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including General and Supplementary Conditions and Division 01 Specifications, apply to this section.

1.2 RELATED SECTIONS

A. Section 01 91 00 - General Commissioning Requirements

B. Section 23 09 63 - Energy Management and Control System (EMCS)

1.3 SUMMARY

A. The commissioning of the lighting system and associated controls as well as the service and distribution equipment shall be performed by an impartial technical firm hired by the owner or shall be performed by the installing contractor if the owner has not hired a commissioning firm. The commissioning provider shall be certified under one or more of the following certifications:
   01 CxA - Certified Commissioning Authority - ACG
   02 CBCP - Certified Building Commissioning Professional - AEE
   03 CCP - Certified Commissioning Professional - BCA
   04 CPMP - Certified Process Management Professional - ASHRAE
   05 BSC - Building System Commissioning Certification - NEBB

B. The commissioning provider (Commissioning authority) shall be responsible for leading the entire construction team through the commissioning process including, but not limited to, conducting the commissioning kick-off meeting, preparing the commissioning plan, preparing pre-functional checklists, preparing functional test scripts, participation in functional testing and preparation of required documentation and reports.

1.4 RESPONSIBILITIES

A. Contractor: Responsibilities of the Contractor as relate to Commissioning Process include, but are not limited to the following:
   01 Facilitate coordination of Commissioning work by Commissioning authority.
   02 Attend Commissioning meetings or other meetings called by Commissioning authority to facilitate the Commissioning Process.
   03 Review Functional Performance Test procedures for feasibility, safety, and impact on warranty, and provide Commissioning authority with written comment on same.
   04 Provide all documentation relating to manufacturer’s recommended performance testing of equipment and systems.
   05 Provide Operations & Maintenance data to Commissioning authority for preparation of checklists and training manuals.
   06 Provide As-built drawings and documentation to facilitate Testing.
   07 Assure and facilitate participation and cooperation of Sub Contractors and equipment suppliers as required for the Commissioning Process.

08 Certify to Commissioning authority that installation work listed in Pre-Functional Checklists has been completed.

09 Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and Pre-Functional Checklists.

10 Provide data concerning performance, installation, and start-up of systems.

11 Provide copy of manufacturers filled-out start-up forms for equipment and systems.

12 Ensure systems have been started and fully checked for proper operation prior to arranging for Testing with Commissioning authority. Prepare and submit to Commissioning authority **written** certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.

a. Contractor shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in Pre-Functional Checklists.

b. Contractor is not relieved of obligation for systems/equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by Commissioning authority.

13 Coordinate with Commissioning authority to determine mutually acceptable date of Functional Performance Tests.

14 Provide qualified personnel to assist and participate in Commissioning.

15 Provide test instruments and communications devices, as prescribed by Commissioning authority, required for carrying out Testing of systems.

16 Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.

17 Ensure deficiencies found in the Commissioning Issues Log are corrected within the time schedule shown in the Commissioning Plan.

18 Provide Commissioning authority with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be routed through Architect.

19 Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

20 Prepare and submit to Commissioning authority proposed Training Program outline for each system.

21 Coordinate and provide training of Owner's personnel.

22 Prepare Operation & Maintenance Manuals and As-Built drawings in accordance with specifications; submit copy to Commissioning authority in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and Commissioning authority's comments.

23 Commissioning requires participation of this Division Subcontractors to ensure that systems are operating in manner consistent with Contract Documents. All costs associated with the participation of Contractor, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

B. Subcontractors and vendors shall prepare and submit to Commissioning Agent proposed Startup procedures to demonstrate proper installation of systems, according to these specifications and checklists prepared by Commissioning authority.

C. Electrical contractor shall provide a letter certifying the installed lighting controls meet documented performance criteria specified in the commissioning plan within 90 days of substantial completion.

1.5 COMMISSIONING PLAN

A. Commissioning Process tasks and activities:
   01 Commissioning kick-off meeting: Conducted by commissioning authority and attended by construction team and design team.
   02 Pre-functional checklists: Prepared by the commissioning authority and filled out by subcontractors performing the work that is applicable.
   03 Site visits to review installation of applicable systems and progress of checklist documentation performed and reported by commissioning authority.
   04 Functional testing: Commissioning authority shall conduct functional testing with assistance of applicable subcontractors and document successful results as well as deficiencies (issues). Functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing in accordance with plans and specifications.
   05 Preliminary commissioning report: Commissioning authority shall issue a preliminary commissioning report to the owner that has results of the first round of functional testing including deficiencies discovered.
   06 Systems manual: Commissioning authority shall compile the systems manual using submittal data provided by the general contractor and applicable subcontractors.
   07 Final commissioning report: Commissioning authority shall issue final commissioning report documenting the entire process and final results of functional testing. Report shall include final testing and balancing report.

B. Electrical System Equipment to be tested
   01 Occupancy sensors.
   02 Time switch controls
   03 Daylighting controls.
   04 Electrical Service and Distribution System.

C. Testing functions and conditions
   01 Daylighting control devices
      a. Verify the devices have been calibrated, properly located and adjusted.
      b. Loads adjust to light level set points in response to daylight.
      c. Location of calibration equipment is accessible to authorized personnel only.
   02 Time switches
      a. Verify schedule, time, date and programming is accurate.
      b. Verify override time limit is set, battery is installed and switch operates the lights that are specified in the design documents.
      c. All specified lights can be turned on and off by area control switch.
      d. Manual override switch allows only the lights in the space where the switch is located turn on or remain on until next scheduled shut off.
   03 Occupant sensors:
      a. Certify the sensor has been located and aimed in accordance with manufacturer recommendations.
      b. For projects with fewer than seven sensors, each sensor shall be tested.
      c. Fore projects with more than seven occupant sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each combination are provided not less than 10 percent shall be tested.
      d. Verify correct operation of status indicators.
      e. Controlled lights turn off or down to the permitted level with in the required time.
      f. For auto-on sensor, the lights turn-on to the permitted level when an occupant enters space.

g. Verify the lights are not incorrectly turned-on by movement in adjacent areas or by HVAC operation.

04 Electrical Service and Distribution System

a. Document the ground resistance testing performed by contractors.
b. Document electrical subcontractor has adjusted breakers to setting recommended by coordination study.
c. Document that any required infrared studies are performed.
d. Document testing of transformer insulation and voltage drop.
e. Document any other testing requirements have been fulfilled as required within specifications.

D. Performance criteria

01 Daylighting controls shall maintain specified light levels within 5% of design.
02 All time switches shall be accurate to time on cellular network devices.

PART 2 - PRODUCTS

2.1 NO PRODUCTS SUPPLIED

PART 3 - EXECUTION

3.1 GENERAL

A. This Division has startup responsibilities and are required to complete sub-systems so COMPLETE SYSTEMS are fully functional. Insuring they meet design requirements of Contract Documents. Commissioning procedures and testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

B. Coordinate with other Sub-Contractors and equipment vendors to set aside adequate time to address Pre-Functional Checklists, Functional Performance Tests, Operations & Maintenance Manual creation, Owner Training, and associated coordination meetings.

C. Commissioning authority will also conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be issued by Architect as deemed appropriate.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete all phases of the work so the systems can be started, adjusted, balanced and otherwise tested.

B. See pertinent specification sections in this Division, which outline responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.

C. Assist Commissioning Agent with all information pertaining to actual equipment and installation as required complete the full commissioning scope.

D. Contractor shall prepare startup procedures to demonstrate compliance with pre-functional checklists, and coordinate scheduling for completion of these checklists.

E. A minimum of seven (7) days prior to date of system startup, submit to Commissioning Agent for review, detailed description of equipment start-up procedures which contractor proposes to perform to demonstrate conformance of systems to specifications and Checklists.

3.3 PARTICIPATION IN COMMISSIONING

A. Attend meetings related to the Commissioning Process; arrange for attendance by personnel and vendors directly involved in the project, prior to testing of their systems.

B. Provide skilled technicians to startup and test all systems, and place systems in complete and fully functioning service in accordance with Contract Documents.

C. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist Commissioning authority in commissioning process.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Complete corrective work in a timely manner to allow expeditious completion of Commissioning Process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be Contractor's responsibility.

3.5 PRE-FUNCTIONAL CHECKLISTS (PFC)

A. Contractor shall complete Pre-Functional Checklists to validate compliance with Contract Documents installation and start-up requirements, for this Division's systems.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

3.6 FUNCTIONAL PERFORMANCE TESTING (FPT)

A. Contractor, in cooperation with Commissioning Agent, shall conduct Functional Performance Testing to validate compliance with Contract Documents.

B. Refer to commissioning plan for detailed list of equipment to be commissioned.

C. Provide commissioning authority with a certificate of readiness to show systems are ready to schedule functional testing.

D. Assist Commissioning authority in Functional Testing by removing equipment covers, opening access panels, etc. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

E. Sampling
   01 Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy.
   02 Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in pre-functional checklist execution.
   03 A common sampling strategy is the "xx% Sampling - yy% Failure Rule", defined by the following example.
      a. xx = the percent of the group of identical equipment to be included in each sample.

b. yy = the percent of the sample that if failing, will require another sample to be tested.
c. The example below describes a 20% Sampling - 10% Failure Rule.
d. Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
e. If 10% (yy) of the units in the first sample fail the functional tests, test another 20% of the group (the second sample).
f. If 10% of the units in the second sample fail, test all remaining units in the whole group.
g. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

F. Re-Testing And Failure To Remedy Deficiencies

01 Despite Contractor’s best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.

02 It is Contractor’s responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.

03 It is Contractor’s responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.

a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond Contractor’s control to resolve expeditiously.
b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)

04 CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving Contractor’s request.

a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, Contractor will be back-charged for CxA’s expenses, and time at a rate of $150.00 per hour and $100.00 expenses, for a third and any subsequent re-inspections and re-tests.

G. Deferred Testing

01 "Seasonal Commissioning” pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.

02 If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.

03 GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.

04 Until off-season commissioning can be accomplished, Owner may retain an amount from GC’s payment sufficient to cover the cost of off-season testing.

05 Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.

06 GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.

3.7 TRAINING

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.

C. The training agenda (plan) shall include, at a minimum, the following elements:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

D. Commissioning Agent shall be responsible for overseeing and approving content and adequacy of training of Owner personnel for all installed systems. Provide Commissioning Agent with training plan two weeks before planned training.

3.8 OPERATIONS & MAINTENANCE MANUALS

A. The following requirements are in addition to Operations & Maintenance requirements specified elsewhere in this specifications manual.

B. Contractor shall compile and prepare documentation for equipment and systems specified in this Division, and shall deliver documentation to Contractor for inclusion in Operation & Maintenance Manuals, in accordance with requirements of Division 01, prior to training Owner personnel.

C. Provide Commissioning authority with a single, electronic copy of Operation & Maintenance Manuals for review. Commissioning authority's copy of O&M manuals shall be submitted through Architect.

D. Operation and maintenance manuals shall include, service agency contact information, maintenance requirements, controls system settings and a narrative of how each system is intended to operate, including set points.

3.9 DOCUMENTATION

A. Commissioning authority shall provide documentation of process as follows:
   01 Preliminary commissioning report including test procedures, results of testing, itemization of deficiencies, deferred tests and climatic conditions required for performance of deferred tests. Preliminary commissioning report shall be issued to owner to demonstrate the first pass of testing has occurred and to demonstrate compliance with applicable codes.

02 Final commissioning report shall include the final test and balance report, final results of functional testing, disposition of deficiencies discovered during testing, including the details of corrective measures used and functional testing procedures used for repeatability of testing in the future.

END OF SECTION

SECTION 26 09 13

ELECTRICAL POWER MONITORING AND CONTROL

PART 1 - GENERAL

1.1 SCOPE

A. Provide quantity of monitoring devices as shown on drawings.

B. Monitoring devices shall include all necessary accessories to be fully functional as described by this specification.

C. Devices shall be UL listed and CE marked.

1.2 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2024.

B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2022.

C. IEC 62053-22 - Electricity Metering Equipment - Particular Requirements - Part 22: Static Meters for AC Active Energy (Classes 0,1S,0,2S and 0,5S); 2020.

D. IEEE C37.90.1 - IEEE Standard for Relays, Relay Systems, and Control Devices Used for Protection and Control of Electric Power Apparatus--Surge Withstand Capability (SWC) and Electrical Fast Transient (EFT) Requirements and Tests; 2024.

1.3 ACCEPTABLE MANUFACTURERS

A. Electro Industries/GaugeTech.

B. Schneider Electric

C. Eaton

D. ABB

E. Siemens

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of devices with ratings, physical dimensions and all accessories clearly labeled.
   02 Device labels shall be clearly indicated in cutsheets.
   03 All standards and listings shall be clearly labeled in cutsheets provided.
   04 Cutsheets shall clearly outline that design requirements of this specification have been met.

1.5 WARRANTY

A. Provide a 4 year warranty on devices.

PART 2 - PRODUCTS

2.1 IMPLEMENTATION

A. Equipment shall be a combination of single-phase, three-phase, and/or multipoint metering assemblies as required to meet the performance of this specification and quantities indicated on plans.

B. Provide enclosures as required by manufacturer.

2.2 DESIGN

A. Power meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.
   01 Meter shall support 3 element Wye, 2.5 element Wye, 2 element Delta, 4 wire Delta systems.
   02 The meter shall accept universal voltage input.
   03 Surge withstand shall conform to IEEE C37.90.1.
   04 The meter shall be user programmable for voltage range to any PT ratio.
   05 Meter shall accept a burden of up to 0.36VA per phase, Max at 600V, 0.014VA at 120 Volts.
   06 The meter shall accept a voltage input range of up to 416 Volts Line to Neutral, and a range of up to 721 Volts Line to Line.
   07 Meter shall accept a current reading of up to 11 Amps continuous.

B. The meter shall include a three line, 0.56” LED display.
   01 The meter shall fit in both DIN 92mm and ANSI C39.1 Round cut-outs.
   02 The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segments.

C. The meter shall support power supply of 90 to 265 Volts AC and 100 to 370 Volts DC. Universal AC/DC Supply shall be available.
   01 Meter power supply shall accept burden of 10VA max.
   02 Meter shall provide upgrade rate of 100msec for Watts, Var and VA. All other parameters shall be 1 second

D. Meter shall be available in transducer only version, which shall not include a display. The meter shall mount directly to a DIN rail.

2.3 OPERATION

A. Power meter shall use a dual input method for current inputs. Method one shall allow the CT to pass directly through the meter without any physical termination on the meter, ensuring the meter cannot be a point of failure on the CT circuit. The second method shall provide additional termination pass-through bars, allowing the CT leads to be terminated on the meter. The meter must support both termination methods.
   01 Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.
   02 Meter shall be programmable for current to any CT ratio. DIP switches or other fixed ratios shall not be acceptable
   03 Meter shall accept burden of 0.005VA per phase, Max at 11 Amps.

04 Meter shall begin reading at a 5mA pickup current.
05 Pass through wire gauge dimension of 0.177” / 4.5 mm shall be available.
06 All inputs and outputs shall be galvanically isolated to 2500 Volts AC.
07 The meter shall accept current inputs of class 10: (0 to 11) A, 5 Amp Nominal, and class 2 (0 to 2) A, 1A Nominal Secondary.

2.4 ACCURACY REQUIREMENTS

A. The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC 62053-22 and ANSI C12.1.
   01 The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.
   02 The meter shall provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.
   03 The meter shall utilize 24 bit Analog to Digital conversion.
   04 Meter shall provide Harmonics %THD (% of total Harmonic Distortion).

B. Meter shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.

2.5 STANDARD FEATURES

A. The meter shall include 2 independent communications ports on the back and face plate, with advanced features.
   01 One port, through backplate, shall be an RJ45 port, providing 100BaseT Ethernet communication speaking BACnet/IP protocol and Modbus TCP, and a Web server.
   02 The meter shall provide an optical IrDA port (through faceplate), as the second communication port, which shall allow the unit to be set up and programmed using a remote laptop PC without need for a communication cable.

B. The meter shall provide user configured fixed window or rolling window demand. This shall allow user to set up the particular utility demand profile.
   01 Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.
   02 All other parameters shall offer max and min capability over the user selectable averaging period.
   03 Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.

C. The meter shall have native BACnet/IP protocol.
   01 The meter shall provide 40 embedded BACnet Objects consisting of standard voltage, current, and power parameters. The Objects shall be named such that they can be readily identified.
   02 The meter shall have an embedded Web interface for configuration and viewing.
      a. The Web interface shall have a Home page with power and energy snapshot information.
      b. The Web interface shall have a page for configuring the BACnet/IP settings, including IP address, Network mask, Default Gateway, and the like.
      c. The Web interface shall allow the user to activate the new configuration and reboot the meter.
      d. The Web interface shall have a feature that lets the user download BACnet Object data as a .csv file that can be viewed in MS Excel© or saved as an MS Excel© file.

e. The Web interface shall have a webpage that displays the BACnet objects, their readings, and information about the objects.
f. The Web interface shall have a webpage displaying statistics for the unit, e.g., the number of meter reboots, and the number of BACnet/IP packets sent and received.
g. The Web interface shall allow the user to discard any changes and return to the saved configuration, or return to the factory default configuration.
h. The Web interface shall be viewable with any standard Internet browser.

03 The meter shall be configurable on the Host PC through LAN configuration.

04 The meter's BACnet/IP shall integrate with any BACnet applications or servers.

05 The meter shall also have an open socket for Modbus TCP that shall be simultaneously available through the LAN interface.

2.6 ENVIRONMENTAL REQUIREMENTS

A. Power meter shall be able to be stored in (-20 to +70) degrees C.

B. Operating temperature shall be (-20 to +70) degrees C.

2.7 FEATURES FOR ENERGY CODE COMPLIANCE

A. Provide meters to monitor, store and report energy data for each end-use category prescribed in energy code.

01 Provide meters with CT's installed on load side of branch circuit breakers. Where load categories are aggregated on a panelboard/switchboard basis and indicated as such on the drawings, meters and CT's can be installed at feeders in lieu of branch circuits.

02 100mA CT's, rated 600V rigidly mounted external to branch breakers

03 1% accuracy or better meters in accordance with ANSI C12.20 with the following readings:
a. Voltage; phase-phase, phase-neutral
b. Current; per phase
c. Active, reactive and apparent power; per phase and total
d. Frequency
e. Phase angle
f. Current demand; per phase and total
g. Maximum values and average values; voltage, current, kWActive, reactive and apparent energy
h. Active, reactive and apparent energy

04 Controller: mounted internal to panelboard/switchboard or external enclosure with the following features:
a. Built-in webpage
b. Inputs for up to 45 single phase meters
c. Two digital inputs to allow data from other metering devices such as gas and water on metered network
d. Provides single slave communication address for entire panel/switchboard
e. Communication protocols: Modbus RTU, Pulse I/O and Modbus TCP/IP or Bacnet/IP
f. Communication to on-site Data Collection Unit (DCU) or EPMS software via communication network infrastructure.

05 Provide a data acquisition system in accordance energy code. Data acquisition system shall consist of an on-site computer with EPMS software or on-site Data Collection Unit to store metered data for a minimum of 36 months. Provide a stand-alone data acquisition system where data integration is not accomplished via energy management and control system (EMCS).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide 6x6x6 NEMA 1 enclosure for meters that are not mounted within electrical gear enclosures.

B. Provide start-up/commissioning by factory representative. Start-up/commissioning shall be coordinated with Engineer or Owner's representative so they may observe.

C. All metering equipment shall be installed in the electrical room of the equipment being metered.

3.2 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

01 Purpose of equipment.
02 Principle of how the equipment works.
03 Important parts and assemblies.
04 How the equipment achieves its purpose and necessary operating conditions.
05 Most likely failure modes, causes and corrections.
06 On site demonstration.

END OF SECTION

SECTION 26 09 36

LIGHTING CONTROLS (STAND-ALONE)

PART 1 - GENERAL

1.1 SCOPE

A. Electrical contractor shall provide a complete lighting control system that controls all interior and exterior lighting fixtures, including emergency fixtures. All lighting controls shall be stand-alone, and shall not have any communication with adjacent spaces. It is the contractor's responsibility to provide a complete and functional system, including, but not limited to all room controllers, switch packs, power packs, occupancy sensors, low voltage control stations, emergency bypass controllers, low voltage control cable, even if not specifically called out on the plans.

1.2 SUMMARY

A. Section Includes:
   01 Digital Occupancy and Daylighting Sensor Control
   02 Emergency Lighting Control
   03 Control Intent – Control Intent includes, but is not limited to:
      a. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
      b. Initial sensor and switching zones
      c. Initial time switch settings
      d. Task lighting and receptacle controls
      e. Emergency Lighting control

1.3 RELATED SECTIONS

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

B. Section 26 02 00 - Basic Materials and Methods for Electrical

C. Section 26 05 19 - Wire, Cable and Related Materials: line and low voltage conductors, dimming conductors, securement requirements.

D. Section 26 27 26 - Wiring Devices

E. Section 26 29 26 - Miscellaneous Electrical Controls and Wiring

F. Section 26 51 19 - Lighting Fixtures - Light Emitting Diode (LED)

1.4 REFERENCES

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

E. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

F. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.5 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control system as defined under this section covers the following equipment:
   01 Room Controllers – Self-configuring and field-configurable, one, two or three relays controllers, 0-10 volt control for drivers (if applicable).
   02 Low Voltage Occupancy/Vacancy Sensors – Self-configuring or field-configurable, Low Voltage, calibrated occupancy sensors, Dual technology or PIR as described by this specification.
   03 Low Voltage On/Off Switches – Self-configuring or field-configurable, Low Voltage pushbutton switches, that may contain one, two, three, or four control zone capability per device.
   04 Low Voltage On/Off Dimmer Switches – Self-configuring or field-configurable, Low Voltage pushbutton switches, Dimmer and scene switches that may contain one, two, three, or four control zone capability per device.
   05 Photosensors – Low Voltage Single-zone closed loop daylighting sensors with switching or dimming control for daylight harvesting.
   06 Configuration Tools – Handheld remote for room configuration provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have, at a minimum, simple pushbutton interface and allow send/receive of room variables and occupancy/vacancy/photo/daylight sensor settings.
   07 Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building. Under loss of normal power, the ELCU shall bypass any control device and ensure fixtures are enabled at 100% light output. Comply with UL 924 and UL 1008 as applicable for each instance. Comply with 26 51 19.

B. System shall accommodate the square-footage coverage requirements for each area controlled, utilizing power packs, occupancy and vacancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

C. Lighting control system shall be configured to fail "on".

D. System shall conform to requirements of NFPA 70.

1.6 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:
   01 Composite wiring and/or schematic riser diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
   02 Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
   03 Riser diagrams to express lighting control hardware and wiring required to meet lighting control sequence of operations.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:
   01 Indicates where sensor is proposed to be installed.
   02 Prove that the sensor is suitable for the proposed application.

1.7 QUALITY ASSURANCE

A. Manufacturer: Minimum 7 years experience in manufacture of lighting controls, unless specifically listed in this specification.

B. Lighting controls shall meet the minimum requirements of ICC (IECC) and ASHRAE Std 90.1 I-P as applicable.

1.8 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   01 Ambient temperature: 0° to 40° C (32° to 104° F).
   02 Relative humidity: Maximum 90 percent, non-condensing.

1.9 WARRANTY

A. Provide a five year complete manufacturer’s warranty on all products to be free of manufacturers’ defects.

1.10 MAINTENANCE

A. Spare Parts:
   01 Provide 5 spares of each product listed below to be used for maintenance.
      a. Room Controllers
      b. Power packs
      c. Occupancy Sensors
      d. Emergency Bypass controllers
      e. Low voltage on/off switches
      f. Low voltage on/off/dimmer switches
      g. Low voltage wall sensor switch
      h. Daylighting harvesting photocells

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. WattStopper

B. Acuity Brands

C. Cooper/ILC/Greengate

D. Sensorworx

E. Steinel

F. ETC

2.2 ALL OCCUPANCY SENSORS (CEILING OR WALL SWITCH)

A. 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.

B. Passive infrared sensors shall utilize Processing protocols to respond only to those signals caused by human motion.

C. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).

D. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

E. 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.

F. 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.

G. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.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.

H. 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.

I. 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.

J. 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.

K. All sensors shall have UL 94V-0 rated plastic enclosures.

L. Outdoor sensors shall have UL 773A ratings. EWF outdoor sensors shall additionally have UL 1598 ratings.

M. Outdoor sensors shall have an operating temperature range of -40°F to +130°F

N. To ensure complete protection from weather elements and exposure, outdoor sensors shall be rated and listed for outdoor use.

O. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology room system. No additional configuration will be required.

P. All devices shall be hard wired. No wireless devices shall be permitted.

2.3 WALL-SWITCH OCCUPANCY SENSOR

A. Manual-ON, Automatic-OFF dual technology (passive infrared and ultrasonic) wall switch occupancy sensor. Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled;

B. 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.

C. 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.

D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

E. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

2.4 WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. provide the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, occupancy sensors and accessories which suit the lighting and electrical system parameters. Passive infrared only sensors shall not be used for classroom applications.

B. Occupancy Sensors shall provide Features include the following: digital or analog calibration and pushbutton/dip-switch/dial programming for the following variables:
   01 Sensitivity – 0-100% in 10% increments
   02 Time delay – 1-30 minutes in 1 minute increments
   03 Test mode – Five second time delay
   04 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
   05 Walk-through mode
   06 Load parameters including Auto/Manual-ON, and daylight enable/disable when photosensors

C. Device Status LEDs including:
   01 PIR Detection
   02 Ultrasonic detection
   03 Configuration mode
   04 Load binding

D. Manual override of controlled loads.

2.5 WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 6 button configuration; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
   01 Two-way infrared (IR) transceiver for use with configuration remote controls.
   02 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.
   03 Configuration LED on each switch that blinks to indicate data transmission.

B. RJ-45 ports, or other manufacturer provided wiring method, for connection of devices on a common system.

C. Plug and play technology. Devices in the same room may be interconnected together and operate in default mode without any programming. Devices in a common space may be connected together, in a manner to be described and installed by the manufacturer's installation guidelines and requirements.

2.6 ROOM CONTROLLERS

A. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers shall be simple to install and may contain dip switches, potentiometers, or other easily adjustable field devices to allow for easy modification. All shall include the following features:
   01 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
   02 Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
   03 Quick installation features including:
      a. Standard junction box mounting
      b. Quick low voltage connections using standard RJ-45 patch cable
   04 Plenum rated
   05 Manual override and LED indication for each load
   06 Dual voltage (120/277 VAC, 60 Hz)
   07 Zero cross circuitry for each load.

B. On/Off/Dimming enhanced Room Controllers shall include:
   01 Real time current monitoring
   02 One, two or three relay configuration
   03 Efficient 250 mA switching power supply
   04 RJ-45 local ports or other manufacturer provided wiring connection methods for connection to other devices on the same system.
   05 One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
   06 The following dimming attributes may be changed or selected using a wireless configuration tool:
      a. Establish preset level for each load from 0-100%
      b. Set high and low trim for each load
      c. Set lamp burn in time for each load up to 100 hours
   07 Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
      a. One relay configuration only
      b. Automatic-ON/OFF configuration

2.7 PHOTOSENSORS

A. Digital photosensors work with room controllers or dimming relay packs to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller/relay pack. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.

B. Digital photosensors include the following features:
   01 An internal photodiode that measures only within the visible spectrum and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrum. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
   02 Sensor light level range shall be from 1-1,000 footcandles (fc).
   03 The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
   04 For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling after they turn off.
   05 For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
   06 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.

C. Closed loop digital photosensors include the following additional features:
   01 An internal photodiode that can be located within a space to remove unwanted light collection from the diode. Wide open light receptors are not permitted. Sensors must be sensitive enough to only detect ambient lighting in the intended detection zone.
   02 Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
   03 Automatically establishes setpoints following self-calibration.
   04 A sliding setpoint control algorithm for dimming daylight harvesting with a “Day Setpoint” and the “Night Setpoint” to prevent the lights from cycling.

D. Open loop digital photosensors include the following additional features:
   01 An internal photodiode that can be located within a space to remove unwanted light collection from the diode. Wide open light receptors are not permitted. Sensors must be sensitive enough to only detect ambient lighting in the intended detection zone.
   02 Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
   03 A proportional control algorithm for dimming daylight harvesting with a “Setpoint” to be maintained during operation.

2.8 EMERGENCY LIGHTING

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
   01 120/277 volts, 50/60 Hz., 20 amp ballast rating
   02 Push to test button
   03 Auxiliary contact for remote test.

B. Include fire alarm interface with all UL 924 and UL 1008 devices.

2.9 POWER PACKS

A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of five (5) sensors.

B. Relay Contacts shall have ratings of 20A, 16A continuous, LED Lighting loads, switched receptacle and associated common motor loads that can be fed by common 5-20R receptacles.

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

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 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. Contractor must arrange virtual or phone meeting with the manufacturer before project rough-in to ensure the hardware, cabling, and overall system requirements are understood and met.

B. All line voltage connections shall be tagged to indicate circuit and switched legs.

C. Test all devices to ensure proper communication.

D. Electrical contractor shall calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

E. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

F. 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.

G. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

H. Contractor shall provide to the manufacturer all quantities for system including but not limited to relays, room controllers, relay panels, plug load controllers, switches, sensors and wire lengths and configurations for device cable at least 1 week before bid.

I. Install all devices as required by manufacturer submitted shop drawings and installation guidelines. Wiring details included with the construction documents are for general scope of work, and exact wiring and connections may vary by manufacturer.

J. The contractor shall coordinate rough-in size and quantity with the number of devices necessary. Since many control devices may accommodate multiple switch legs in a single gang, there may be an indirect relationship between number of devices and number of control zones.

K. Provide J-hooks for supporting all low-voltage cabling at a spacing not to exceed 5 ft. between hooks.

L. Provide dimming conductors for all dimming zones, as indicated by presence of dimmer devices on the plans.

M. The lighting control system must function within the guidelines stated in the lighting control sequence of operation notes, details, matrices, and narratives on the plans.

3.3 COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by a commissioning agent representative who will verify a complete fully functional system is installed as required by plans and specifications.

B. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

01 Purpose of equipment.
02 Principle of how the equipment works.
03 Important parts and assemblies.
04 How the equipment achieves its purpose and necessary operating conditions.
05 Most likely failure modes, causes and corrections.
06 On site demonstration.

END OF SECTION

SECTION 26 21 13

ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Power company fees shall be paid by Owner.

C. Provide electrical service to comply with contract documents and the power company standards.

1.2 SCOPE

A. RELATED WORK:
01 Basic Electrical Materials and Methods.
02 Earthwork
03 Division 1

B. Permanent Power: Contractor shall coordinate with the power company to provide electrical service to the building or campus as shown on the drawings. Contractor shall coordinate with power company and submit all required documentation; and shall establish the sequence of work to obtain permanent power.

C. Temporary Power: Provided by the contractor.

1.3 PERMITS, CODES, LAWS AND ORDINANCES

A. NFPA-70, NEC, State and local.

1.4 MINIMUM COMPLIANCE STANDARDS

A. Easements required by power company.

B. Duct bank required by power company.

PART 2 - PRODUCTS

2.1 ELECTRICAL SERVICE

A. SERVICE TRANSFORMER: Pole Mounted.

B. Terminal pole shall be provided by the power company.

C. POWER COMPANY: CenterPoint Energy.

D. SOURCE VOLTAGE: 480Y/277 volt, three phase, four wire system.

2.2 CABLE TAP BOX

A. Provide when required by the power company for terminating additional conductors in which the power company transformers terminations are exceeded or for metering.

2.3 METERS

A. Provide metering as required by Electric Utility Company Standards and requirements which may include self-contained meters and sockets, current transformers (CT's) and CT enclosures, bussed CT enclosures, transockets, meter modules, and bussed gutters and meter assemblies.

PART 3 - EXECUTION

3.1 SERVICE LATERIAL

A. Route service lateral underground from weather head to main service disconnect.

3.2 COORDINATION

A. Confirm with power company exact locations of service entry and other requirements.

B. Provide all service laterals, whether above ground or below ground, in accordance with utility company engineered drawings. Information shown on contract documents may vary slightly from utility company engineered drawings and all utility company drawings and specifications shall supersede these contract drawings.

C. All electrical service infrastructure, up to the point of delivery, shall be installed per utility company standards. Plans and details included in these contract documents do not depict exact installation details as they may be required by the utility company.

3.3 CONCRETE PADS

A. Provide steel reinforced concrete pads with leave outs for conduits to comply with power company standards. Refer to Basic Materials and Methods.

3.4 INSTALLATION

A. Provide concrete encased secondary service lateral ductbank, including any and all steel reinforcement, conduit spacers and straps

B. All unmetered conductors shall be installed in rigid steel conduit, where installed above grade.

3.5 STEEL STRUCTURES

A. Provide galvanized steel structure embedded in concrete to support metering equipment and disconnect switches.

END OF SECTION

SECTION 26 22 13

LOW VOLTAGE DISTRIBUTIONS TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 480 volt primary step down transformers as shown, scheduled and as specified.

B. The type of transformers required includes dry-type general purpose transformers.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable ANSI/IEEE and NEMA standards.

B. All low voltage transformers shall be UL listed and labeled.

C. All low voltage transformers 15 kVA and larger shall meet or exceed post-January 1, 2016 U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015) regardless of whether transformer date of manufacture is pre or post January 1, 2016.

D. All low voltage transformers 15 kVA and larger shall be tested for efficiency in accordance with U.S. DOE test methods Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015).

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers for general purpose use:
   01 General Electric Company/ABB
   02 Square D Company
   03 Power Quality International
   04 Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of transformers with sound and load ratings, dimensions, weights, impedance rating, insulation type, temperature rise and tap configurations.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. National Electrical Code.

B. Local, municipal, and/or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE

A. Provide dry type, two-winding transformers with primary and secondary voltages and KVA ratings as shown on plans. Transformers shall operate at 60 hertz. All transformers shall be manufacture with standard materials and components.

2.2 MATERIALS AND COMPONENTS FOR GENERAL PURPOSE TRANSFORMERS

A. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with structural steel angles. The completed core and coil shall be isolated from the base by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. The vibration isolating system shall be designed to provide a permanent fastening of the core and coil to the enclosure. Sound isolating system requiring the complete removal of all fastening devices will not be accepted. Windings shall be copper or electrical grade aluminum terminated on tin plated or copper bars. Foil windings are not acceptable.

B. The transformer core shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with NEMA, IEEE and ANSI standards.

C. Transformer coils shall be of continuous-wound type construction and shall be impregnated with non-hygroscopic, thermo-setting varnish.

D. Transformers shall be enclosed in drip-proof, metallic enclosures designed to provide for air cooling and prevent accidental contact with live conductors. Wiring compartment shall be located below the core and coil and cooled by air circulation or insulated from the core and coil by means of a suitable thermal insulation barrier. Transformer exposed to weather or installed in a sprinkled area shall have rain shields on all openings. Entire transformer enclosure shall be cleaned, phosphatized, primed and painted with a gray, baked enamel.

E. Transformers shall operate at 100% nameplate KVA rating continuously while in a 40 degree C ambient without exceeding the rated average winding temperature rise of the ANSI insulation system as described below.

Temperature rating shall be as follows:

RATING	PHASE INSULATION-TEMP. RISE
0.025 through 3 KVA	SingleType B - 80º C
5 through 25 KVA	SingleType F - 115º C
3 through 15 KVA	ThreeType F - 115º C
37½ KVA and larger	SingleType H - 150º C
30 KVA and larger	ThreeType H - 150º C

F. Transformers shall have minimum full load rated taps in the primary windings as follows:

RATING	TAPS
3 through 25 KVA	2 - 5% FCBN
15 through 300 KVA	6 - 2-½% TAPS, 2 above and 4 below nominal

G. Maximum sound ratings shall be as follows:

KVA	dBA

0 to 9	40
10 to 50	45
51 to 150	50
151 to 300	55
301 to 500	60

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install transformer in accordance with manufacturer`s written instructions, and recognized industry practices.

B. Housekeeping Pad: Provide a nominal 3-½" high, 2500 PSI (28 Day) concrete reinforced pad with number 6 welded wire mesh. The pad shall conform to the shape of the transformer and extend at least 3 inches beyond the length and width of the transformer. All corners of the pad shall be rounded.

C. Mounting: Install floor mounted transformers on properly sized rubber-in-shear vibration isolators. Trapeze mounted transformers shall use rubber-in-shear hangers. Wall mounted transformers shall not be mounted directly to the wall without vibration isolation.

D. Connection: Route conductors in a minimum of 2 feet of flexible steel conduit to transformer enclosure. Provide grounding conductor sized per NEC, connected to the building grounding electrode system.

3.2 TESTING

A. Insulation, Tests: Prior to energization, check transformers windings for continuity and test the insulation resistance. Tests shall be made using a Biddle Megger or equivalent test instrument, per manufacturers' recommendations. Provide written documentation of testing. Submit with O & M manuals.

B. Tap Setting: Measure current and voltage under load conditions to provide correct tap settings.

END OF SECTION

SECTION 26 22 22

LOW VOLTAGE HARMONIC MITIGATING DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 480 - 208Y/120 volt 3 phase, 4 wire transformers as shown, scheduled and as specified.

B. The type of transformers required are dry-type harmonic mitigating transformers.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable ANSI/IEE and NEMA standards.
   01 All low voltage transformers shall be UL listed and labeled.
   02 All low voltage transformers 15 kVA and larger shall meet or exceed post-January 1, 2016 U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015) regardless of whether transformer date of manufacture is pre or post January 1, 2016.
   03 All low voltage transformers 15 kVA and larger shall be tested for efficiency in accordance with U.S. DOE test methods Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015).

1.3 ACCEPTABLE MANUFACTURERS

A. Power Quality International, Inc. (PQI)

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of transformers with sound and load ratings, dimensions, weights, impedance rating, insulation type, temperature rise, phase displacement and tap configurations.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. National Electrical Code.

B. Local, municipal, and/or state codes that have jurisdiction.

1.6 DESIGN OBJECTIVES

A. The design of the electrical distribution system, as described by this specification and detailed in the accompanying electrical drawings, provides for control of the harmonic currents that are generated by non-linear electronic loads. These design objectives, and the various standards that apply, are detailed herein as follows:
   01 To reduce the ‘penalty losses’ that are produced by harmonic currents, which would otherwise result in an increase in the cost-of-power, apparatus heating and the cost of air-conditioning, within economic limits.

02 To limit harmonic current injection into the Point of Common Coupling (PCC), as required in IEEE 519 , Section 10.4, Table 10.3.

03 To limit positive, negative and zero sequence harmonic currents in the distribution system so that the Individual Harmonic Distortion of Voltage (IHDv) levels do not exceed 3% at the loads and the Total Harmonic Distortion of Voltage (THDv) levels do not exceed 5% at the loads, as recommended in IEEE 519, Section 6.6, Paragraph 2.

04 To limit zero sequence harmonic currents in the neutral conductors so that their ratings are not exceeded and Common Mode Noise (CMN) neutral-ground voltage levels do not exceed 5 volts at the loads, as recommended by CBEMA. Where computers and/or audio/visual devices are interconnected into a communications 'network', to limit the difference in CMN to < 2 volts at all loads, as recommended by EPRI.

1.7 FACTORY TESTING

A. The manufacturer shall provide linear and non-linear efficiency test on each transformer. Transformers not meeting the following criteria will not be used on this job. The data shall be included in the Operations and Maintenance Manuals. The tests shall be conducted between 0% and 100% full load and shall be plotted for each transformer.

01 Linear Load Efficiency: Transformer shall meet or exceed post-January 1, 2016 U.S. DOE efficiency requirements Energy, 10 C.F.R. §431.196(a)(2) (2015) regardless of whether transformer date of manufacture is pre or post January 1, 2016. Proof of compliance Type Tests, for each transformer type and rating, must be based on U.S. DOE test methods Energy, 10 C.F.R. §431, Subpart K, Appendix A (2015). Type Test are required with each submission.

02 Non-Linear Load Efficiency: This requirement is defined as meeting the efficiency requirements of NEMA TP1-2002 under non-linear loading, which has 100% THDI and a harmonic profile that is based on IEEE 519, Table 4.3 - 'Spectrum of Typical Switch Mode Power Supplies'. Proof of compliance Type Tests, for each transformer type and rating, must be based on the Voltage and Current Difference Loss Measurement Method using laboratory grade CTs and 0.1% accuracy Wattmeters OR shall be calculated in accordance with IEEE C57.110. Type Tests are required with each submission. The Power In – Power Out Measurements Method is not an acceptable test method due to the limitations associated with CT, PT and WattMeter accuracy.

1.8 FACTORY NAME PLATES

A. Provide two (2) – name plates per transformer indicating all code required items (i.e. kVA voltage, phase etc.). Name plates shall also include, phase shift and a name as indicated on transformer schedule or one-line diagram. The name plates shall be located on a non removable section of the outer shell.

1.9 ALTERNATES

A. In the event the contractor wishes to propose an alternative to the specified Harmonic Mitigating Transformers and/or Zero Sequence Harmonic Filters, the contractor shall provide the engineer with a detailed alternate Harmonic Mitigation Plan, which includes a schedule of proposed replacement devices that will meet all of the requirements described in this specification. The equipment proposal from the non-specified vendor(s) shall include the following information:

01 Evidence of significant relevant application experience.

02 Quantitative performance data including before/after effect on voltage distortion at the loads that demonstrates the vendor's capability to achieve the harmonic treatment called for in this specification.

03 Product technical specification and installation wiring diagram.
04 Pertinent product application information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type 'DV', Single Output, Harmonic Filtering Distribution Transformers (Dry Type) shall be provided for all transformers indicated with a zero (0), thirty (30), fifteen (15), forty-five (45), twenty (20) and forty (40) degree primary to secondary phase shifts.

B. Harmonic mitigating transformers with Wye configured primary windings are not acceptable.

C. Harmonic mitigating transformers without zig-zag configured secondary windings that completely cancel zero-sequence flux under balanced load conditions are not acceptable.

2.2 PRODUCT DESCRIPTION

A. The design of the harmonic filtering transformers, described in this Specification, shall be optimized for harmonic rich environments that are characterized by high neutral currents. These transformers shall:
01 Provide an ultra-low zero sequence impedance path for all load-generated zero sequence harmonic currents, including I_3, I_9, I_{15}, I_{21}, etc.
02 Provide for the cancellation of the 5th, 7th, etc. positive and negative sequence harmonic currents, at the units' primary bus, when 0° and 30° (15° and 45°) phase-shifting units are used in combination.
03 Provide for the cancellation of the 5th, 7th, 11th, 13th, etc. positive and negative sequence harmonic currents, at the units' primary bus, when 0°, 20° and 40° phase-shifting units are used in combination.
04 Provide for the cancellation of 5th, 7th, 11th, 13th, 17th, 19th, etc. positive and negative sequence harmonic currents, at the units' primary bus, when 0°, 15°, 30° and 45° phase-shifting units are used in combination.
05 Harmonic cancellation shall be by electromagnetic means only. No capacitors or electronics shall be used.
06 Reduce voltage and current distortion and imbalance at the primary terminals of the unit.
07 Reduce current crest factor at the primary terminals of the unit.
08 Reduce average and peak phase current on the primary terminals of the unit.
09 Reduce system losses.
10 Improve system power factor.
11 Reduce voltage distortion in the secondary sub-system.

2.3 DEVICE CONFIGURATION

A. Type: ANN

B. Insulation Class: 220°C

C. Temperature Rise: 150°C

D. System Frequency: 60 Hertz

E. Primary Voltage: 480 Volts Delta (Wye configured primary is not acceptable)

F. Secondary Voltage: 208/120 Volts Zig-Zag with two (2) windings per core leg for 0 degree phase shift and 208/120 Volt modified zig-zag with three (3) windings per core leg for 30, 15, 45, 20 and 40 degree phase shifts.

G. Phase: Three Phase

H. Rating: as scheduled on drawings

I. Primary-Secondary Phase-Shift: as scheduled on drawings

2.4 TRANSFORMER CHARACTERISTICS

A. Key Requirements
- 01 Positive & negative sequence impedance: standard %
- 02 Zero sequence reactance at 60Hz: < 0.3 %
- 03 Zero sequence impedance at 60Hz: < 0.9 %
- 04 Crest Factor suitability: 5
- 05 BIL: 10,000 Volts (windings 1000V
- 06 Capability to deliver full nameplate kVA to loads of K-factor up to: 30
- 07 Neutral connection shall be rated at two times the ampacity of the secondary phase current.

B. Basic Requirements:
- 01 Built to the following Standards: CSA C9-M1981, CSA22.2 No.47-1977, UL 506, IEEE C57.110, and NEMA ST 20
- 02 Three-phase, common core construction
- 03 Convection air-cooled
- 04 Copper or Aluminum Windings
- 05 Insulation Class: R(200 degree C)
- 06 Magnetic field at 1.5 feet: max. 0.1 Gauss
- 07 Full load Efficiency at 170°C
- 08 Magnetizing Inrush Current: max. 10 times full load rating
- 09 Taps: 2 x ± 2.5%
- 10 Sound level: per C57.12.91
- 11 Enclosure: ventilated, drip-proof NEMA-1 totally enclosed
- 12 Finish: PQI white power coat
- 13 Anti-vibration pads shall be used between the core and the enclosure

2.5 VENDOR INFORMATION

A. Evidence of significant relevant application experience.

B. Quantitative performance data including before/after effect on voltage distortion at load panels that demonstrates the capability to achieve the harmonic mitigation called for in this specification.

C. Product technical specification.

D. Pertinent product application information.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install transformer in accordance with manufacturer's written instructions, and recognized industry practices.

B. Housekeeping Pad: Provide a nominal 3-½" high, 2500 PSI (28 Day) concrete reinforced pad with number 6 welded wire mesh. The pad shall conform to the shape of the transformer and extend at least 3 inches beyond the length and width of the transformer. All corners of the pad shall be rounded.

C. Mounting: Install floor mounted transformers on properly sized rubber-in-shear vibration isolators. Trapeze mounted transformers shall use rubber-in-shear hangers. Wall mounted transformers shall not be mounted directly to the wall without vibration isolation.

D. Connection: Route conductors in a minimum of 2 feet of flexible steel conduit to transformer enclosure. Provide grounding conductor sized per NEC, connected to the building grounding electrode system.

3.2 FIELD TESTING

A. Insulation, Tests: Prior to energization, check transformers windings for continuity and test the insulation resistance. Tests shall be made using a Biddle Megger or equivalent test instrument, per manufacturers' recommendations.

Continuity Check

Primary	Pass / Fail		Secondary	Pass / Fail
H_1-H_2			X_1-X_0	
H_2-H_3			X_2-X_0	
H_3-X_1			X_3-X_0	

Insulation Resistance Test (1000V, DC)

Connections	Megohms
High to Low, Gnd	
Low to High, Gnd	
High, Low to Gnd	

B. Tap Setting: Measure current and voltage under load conditions to provide correct tap settings.

Tap Setting	Primary Voltage Reading		Secondary Voltage Reading	
	H_1-H_2		X_1-X_0	
	H_2-H_3		X_2-X_0	
	H_3-X_1		X_3-X_0	

C. Receptacle Tests: At the furthest receptacle from each panel serving a computer or copier, a power quality meter shall be used to determine the following:

Receptacle Test	
Panel Name (Fed From)	
Circuit Number	
Room Name or Number	
Location Inside Room	
Voltage (Line-Neutral)	

THD_V	
Voltage (Neutral-Ground)	
Current (Phase)	
THD_I	

D. Conduct all tests 3 to 6 months after building occupation. Submit all tests for Engineer's review.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Provide panelboards as shown, scheduled and as specified herein.

B. The types of panelboards include:
   01 Panelboards.
   02 Power distribution panelboards.

1.2 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2024.

B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2022.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

E. UL 67 - Panelboards; Current Edition, Including All Revisions.

F. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

G. UL 943 - Ground fault Circuit Interrupters

H. NEMA PB 1 - Panelboards

I. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

J. NEMA, ABI, Molded Car Circuit Breakers and Molded Case Switches

K. Federal Spec W-P 115, Rev C, Panel, Power Distribution

L. NEMA KSI, Enclosed and Miscellaneous Distribution Equipment Switches (600V)

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   01 General Electric Company/ABB
   02 Square D Company
   03 Siemens
   04 Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of all enclosures, circuit breakers, fusible switches, bussing, rating, schedules and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   01 NFPA 70
   02 Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General
   01 Provide power distribution and panelboards as indicated in the panelboard schedule and as shown on the plans. Power distribution panelboards shall be equipped with fusible switches or circuit breakers as shown on the schedule. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule.

B. Busing Assembly and Temperature Rise
   01 Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 65°C. rise above 40°C ambient. Heat rise test shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. All current carrying parts of the bus shall be tin or silver plated copper.
   02 Bus structure shall be isolated. Bus bar connections to the branch circuit breakers shall be distributed phase or phase sequence type and shall accept bolt-on circuit breakers for lighting and appliance panelboards.
   03 The lugs for terminating conductors shall be rated at 75°C on all panel boards and circuit breakers.
   04 Provide a non-insulated bare copper ground bus. Provide an isolated ground copper bus in each panel serving isolated ground circuits as indicated on panel schedule or one-line diagram. Provide a full size copper neutral bus in each panelboard enclosure. Provide a 200% neutral buss when served by a harmonic mitigating transformer and any K4 or higher rated transformers.

C. Distribution Panelboards
   01 Provide arc energy reduction switch for each overcurrent device rated 1,200 amps or larger to comply with 240.87 of the NEC. Switch shall be equipped with a pad lockable cover with a blue LED pilot light that illuminates when system is activated. Locate switch and cover recessed mounted adjacent to the switch it serves or remote as indicated on the plans. Provide label and all required hardware. Remote switch(es) shall be flush mounted in wall near entry to the room.

02 Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between “ON” and “OFF”. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall be of the frame size, trip setting and interrupting capacity as indicated on the drawings. Circuit breakers shall be rated 65,000 AIC unless otherwise noted on plans.

D. 480/277 Volt Panelboards

01 Main breakers shall be vertically mounted. Branch mounted main breakers are not acceptable. Provide electronic trip mains with long term, short term and instantaneous trips as indicated on drawings and required for selective coordination.

02 Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2 or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breaker shall have an over-center, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have “ON”, “OFF” and “TRIPPED” positions. Circuit breakers shall be UL listed in accordance with UL Standard 489 and shall be rated 277 volt ac (single pole, 15-30 amperes) or 480Y/277 volts ac (2 and 3 pole) with continuous current ratings as noted on the plan. Interrupting ratings shall be a minimum of 18,000 rms symmetrical amperes at 277 volts ac (single pole) or 480Y/277 volts ac (2 and 3 pole) unless otherwise noted on plans.

03 Provide circuit breakers with lock-on devices for applications where dedicated branch circuits are serving battery-equipped emergency lighting fixtures, exit signs or fire alarm equipment per Article 700 of NFPA 70.

E. 240 Volt Panelboards

01 Main breakers shall be vertically mounted. Branch mounted main breakers are not acceptable. Provide electronic trip mains with long term, short term and instantaneous trips as indicated on drawings and required for selective coordination.

02 Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2, or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breakers shall have an overcenter, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have "ON", "OFF" and "TRIPPED" positions.

03 Circuit breakers shall be UL listed in accordance with UL 489 and shall be rated 240 volts ac maximum with continuous current rating as noted on the plans.

04 Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip settings of the breaker to prevent repeated arcing short resulting from frayed appliance cords. Single pole 15 and 20 ampere circuit breakers shall be UL listed as "Switching Breakers" at 120V ac and carry the SWD marking.

05 UL Class A 5mA ground fault circuit protection shall be provided on all receptacle circuits serving wet areas and on all 120V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional circuit breaker.

06 UL Class B 30mA ground fault circuit protection (GFEP) shall be provided on all equipment circuits requiring ground fault protection. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring.

07 Provide Shunt Trip Breakers including control power for circuits under cooking hoods and other equipment having this requirement.

08 Provide Breakers with Switched Neutral circuits with common trip for gasoline pumps and other equipment having this requirement.

09 Circuit breakers shall be rated 10,000 AIC at 240V unless otherwise noted on plans or served by transformers greater than 150 kVA.

10 Provide 200% sized neutral bus with panels served from a non-linear transformer and any K4 or higher rated transformers. This shall be a UL approved assembly.

11 Provide circuit breakers with lock-on devices for applications where dedicated branch circuits are serving battery-equipped emergency lighting fixtures, exit signs or fire alarm equipment per Article 700 of NFPA 70.

F. Cabinets and Fronts

01 The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL 50 for cabinets. Wiring gutter space shall be in accordance with UL 67 for panelboards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel. All NEMA-1 panels shall have hinged front covers. The front cover shall have a door with hinges, latch and a lock. The piano hinged front covers door-in-door shall allow full access to the circuit breaker gutter area without having to remove the entire front cover. All panelboard lock shall be keyed alike. Circuit breaker and fusible distribution panels shall have four-piece trims. A welded circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Provide NEMA 1 enclosure where installed indoors unless otherwise noted. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

G. Safety Barrier

01 The distribution panelboard interior assembly shall be dead front with panelboard cover removed. Main lugs or main breakers shall have a barrier. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

H. Integrated Equipment Short Circuit Rating

01 Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the over-current devices mounted in the panelboard. The short circuit tests on the over-current devices and on the panelboard structure shall be made simultaneously by connecting the fault to each over-current device with the panelboard connected to its rated voltage source. Method of testing shall be per UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard over-current devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

I. Metering

01 Provide a branch circuit meter to meter the branch circuits indicated on the drawings. It shall provide kW, kVA, kWh and kVAh. It shall be mounted in the panelboard or externally mounted next to the panel. Communication protocol shall include BACnet and Modbus TCP over ethernet. Connect to the Building Automation System. Program to notify building owner if the load exceeds values set by the energy code indicated on the load analysis. This shall comply with Article 220.42 of NFPA 70.

02 Provide a panelboard meter to meter the entire panel as indicated on the drawings. It shall include per phase and total kW, kVA, accumulated kWh, kVAh, power factor, peak demand, frequency, current and voltage It shall be mounted in the panel board or externally mounted next to the panelboard. Communication protocol shall include BACnet and Modbus TCP over ethernet. Connect to the Building Automation System. Program to notify building owner if the load exceeds values set by the energy code indicated on the load analysis. This shall comply with Article 220.42 of NF. Connect the meter to the building automation system before entergizing.1

03 Meters shall be provided with an accuracy of 1.0% and shall be certified to ANSI C12.1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards, including electrical connections, in accordance with manufacturers written instructions, NFPA 70 and recognized industry practices.

B. All panels shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

C. Housekeeping Pads: Mount floor mounted panelboards on 4 inch high concrete housekeeping pads.

D. Fuses: Install fuses of the rating and class as shown in each fusible distribution panel scheduled on drawings.

E. Conduits: Stub up three one inch conduits to an accessible location above the ceiling for each recessed panelboard.

3.2 IDENTIFICATION

A. Nameplate: Each panelboard shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show panel designation. Nameplates shall be attached with stainless steel screws. Refer to Section 26 02 00, paragraph 2.8(C).

B. Directory Card: Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include location and name of each item of equipment served. Spares and spaces shall be written in erasable pencil for future use. Circuit directory shall show the room served by each circuit. The final graphs/signage room numbers shall be used. Do not use Architectural numbering on plans.

C. Replacement Components: Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturers, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state "caution - Series Rated System." (NEC 110-22). Nameplate shall also identify replacement components.

3.3 INFRARED SCANNING

A. After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner. Submit a copy the owner and engineer for review. If O&M manuals are submitted prior to performance of infrared scan, contractor shall submit a signed letter to verify the scan has been arranged. Letter shall indicate the scan provider and the date It will be performed.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE

A. Provide wiring devices as shown, scheduled, required and as specified.

B. The types of wiring devices required include:
   01 Switches
   02 Receptacles
   03 Occupancy Sensors
   04 Digital Timer Switches
   05 Coverplates

1.2 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).

C. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

D. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

G. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

H. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

I. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

J. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.3 QUALITY ASSURANCE

A. All wiring devices shall comply with NEMA WD 1 and NEMA WD 6 as well as FS W-C-596 and FS W-S-896 as applicable.

B. All switches shall comply with UL 20 as applicable.

C. All receptacles shall comply with UL 498 as applicable.

D. All GFCI receptacles shall comply with UL 943.

E. All USB charging receptacles shall comply with UL 1310.

F. All AFCI receptacles shall comply with UL 1699.

1.4 ACCEPTABLE MANUFACTURERS

A. Hubbell

B. Leviton

C. Pass & Seymour

1.5 SUBMITTALS

A. Shop drawings shall include but not be limited to:
   01 Cut sheets of all devices indicating NEMA configuration, rating, materials, color, and all accessories.
   02 Cut sheets of all coverplates indicating materials, color and any engraving specified on drawing or in the specifications.

1.6 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH

A. National Electric Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. GENERAL
   01 Provide factory assemble wiring devices with the rating type and color as required and specified for the service indicated.
   02 Provide matching one-piece multiple gang plates where switches are ganged.
   03 Provide wall plates for each receptacle furnished.
   04 Architect reserves the right to select wiring device styles and colors to match wall finish.
   05 Wall plates shall be of same manufacturer as devices.

2.2 SWITCHES

A. Provide specification grade White toggle switches where indicated on the Drawings. Provide "Red" switches for switching emergency lighting circuits where switching is indicated. Coordinate exact locations and color with architect.
   01 Wall switches shall be 20 amp, 120-277 volt and shall be Hubbell, Leviton or P&S as follows:

TOGGLE SWITCHES	HUBBELL	LEVITON	P&S
SINGLE POLE	HBL1221	1221-2	PS20AC1
DOUBLE POLE	HBL1222	1222-2	PS20AC2
THREE WAY	HBL1223	1223-2	PS20AC3
FOUR WAY	HBL1224	1224-2	PS20AC4
MOMENTARY CONTACT	HBL1557	1257	1251

THREE POSITION, TWO CIRCUIT MAINTAINED CONTACT	HBL1385	1285	1225
KEY TYPE LOCKABLE BARREL KEY OR CORBIN STYLE	HBL1221-RKL	1221-2KL	PS20AC1-KL
PROVIDE WITH EXTRA KEYS	HBL1209RKL	2KL	4609
DISCONNECT SWITCH / INSTA HOT	HBL7810DS	MS303-DSS	7803

02 Dimmers: Provide Lutron DIVA or equal as shown on drawings. Wall box dimmers shall be sized to handle the load served. Provide phase dimmers to control LED lamps when 0-10 volt dimming drivers are not provided.

03 Light Handle Switches: Provide Hubbell HBL1221-IL, Leviton 1221-LHC, P&S PS20AC1-ISl lighted handles to switch emergency lights where noted on the drawings.

2.3 RECEPTACLES

A. Provide specification grade White receptacles where indicated on the drawings. Provide “Red” receptacles for receptacles on emergency power. Coordinate exact location and color with architect.

01 Receptacles shall be Hubbell, Leviton or Pass & Seymour as follows:

CONVENTIONAL RECEPTACLES	HUBBELL	LEVITON	P&S
HEAVY DUTY BRASS MOUNTING YOKE NEMA 5-20R DUPLEX	HBL5352	5362	5362
HEAVY DUTY BRASS MOUNTING YOKE NEMA 5-20R SIMPLEX	HBL5361	5361	5361
ISOLATED GROUND 20A, 125V ORANGE NEMA 5-20R DUPLEX	IG5352	5362IG	IG5362
CLOCK HANGER 15A-125V BROWN WITH STAINLESS STEEL PLATE WITH HANGER	HBL5235	5361-CH	S3733-SS
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER RESISTANT FOR LOCATIONS REQUIRING TAMPER RESISTANT INSTALLATION OR AS INDICATED ON THE DRAWINGS	GFRST20	GFTR2	2097TR
GFCI DUPLEX 20A, 125V SELF TESTING, FEED THRU CAPABLE, TAMPER/WEATHER RESISTANT FOR INSTALLATION IN DAMP/WET LOCATION OR AS INDICATED ON THE DRAWINGS	GFTWRST20	GFWR2	2097TRWR
HEAVY DUTY TAMPER RESISTANT BRASS MOUNTING YOKE	HBL5362WTR	5362-SG	---
TAMPER RESISTANT 20A, 125V DUPLEX	BR20WHITR	8300-SG	TR63-H
SURGE PROTECTION 20A, 125V DUPLEX, BLUE NEMA 5-20R WITH AUDIBLE ALARM	HBL5362SA	7380-B	5362SP

USB CHARGER TYPE DUPLEX 20A, 125V TAMPER RESISTANT, DUAL USB TYPE A PORTS MIN. OF 5A USB OUTPUT, TAMPER RESISTANT	USB20A5x 5A OUTPUT	T5832* 3.6A OUTPUT	2097TRUSBA4* 2.1A OUTPUT
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH TWO CONTROLLED FACES	BR20C2WHITR	TBR20-S2W	TR5362CDW
PLUG LOAD CONTROLLED RECEPTACLES 20A, 125V TAMPER RESISTANT WITH ONE CONTROLLED FACE	BR20C1WHITR	TBR20-S1W	TR5362CHW
ARC FAULT CIRCUIT INTERRUPTER RECEPTACLES	AF20TRW	AFTR2-W	AF202TRW
GROUND FAULT CIRCUIT INTERRUPTER / ARC FAULT DUAL FUNCTION	AFGF20TR	AGTR2-W	AFGF202TR

2.4 OCCUPANCY SENSORS

A. Provide White dual technology wall mounted sensors, provide one of the following:
   01 Single Pole:
      a. Wattstopper #DSW301
   02 Double Pole:
      a. Wattstopper # DSW302
   03 Dimmer:
      a. Wattstopper #DW311

B. Provide dual technology ceiling sensor with low voltage controlling switch and power pack.
   01 Single Button:
      a. Wattstopper # DT300 Sensor, BZ150 Power Pack and LVSW101 Digital Switch

C. Provide Ultra Sonic Ceiling sensor for restrooms.
   01 Wattstopper #UT3000, BZ150 Power Pack

2.5 DIGITAL TIMER SWITCHES

A. Provide Wattstopper TS-400-G digital timer.

B. The time switch shall provide audible notification and visual notification (blink the room lights) prior to turning lights off.

C. The time switch shall have a 12-hour manual override setting.

2.6 COVERPLATES

A. Furnish and install coverplates on all outlet boxes. Oversize (Jumbo) coverplates are not acceptable.

B. Coverplates shall be 302/304 smooth stainless steel and 302/304 smooth stainless steel in kitchen and coffee bar areas.

C. Provide Hubbell WP Series, Bell, Carlon or Leviton NEMA 3R weatherproof coverplates on all exterior wiring devices. Enclosure shall be suitable for wet locations when in use.

D. Coverplates shall be Hubbell SS Series, Leviton, Pass & Seymour 302/304 smooth stainless steel on all receptacles 30 amps and larger.

E. Stainless steel device plates shall be provided at locations with tile or stone walls.

PART 3 - EXECUTION

3.1 WIRING DEVICE MOUNTING HEIGHTS

A. Unless noted to the contrary on plans, or directed otherwise during the progress of the Work, wiring devices shall be set as follows:
   01 Switches 42" above finished floor.
   02 Wall mounted receptacles shall be installed vertically at 15 inches to the bottom outlet above finished floor unless otherwise noted or as required by local codes.
   03 Wall telephone outlets shall be mounted 15 inches to the bottom above finished floor unless otherwise noted. Mount even with wall mounted receptacles.
   04 At locations above counters, set devices at 6 inches above to the centerline counter tops, verify exact mounting height with the architect.

3.2 INSTALLATION (REFER TO 26 05 33 FOR OUTLET BOX SPECIFICATIONS)

A. Wall switches shall be set in a suitable steel box and shall be installed on the strike side of the door as finally hung, whether so indicated on the Drawings or not.

B. Receptacles shall be installed in a suitable steel box.

C. The Architect reserves the right to relocate wiring device up to a distance of 5 feet from the location shown, before rough-in, without additional cost.

D. Provide multi-gang device covers at locations where devices gang together.

E. Device locations are indicated schematically on the drawings along with the type and mounting height. Final locations and mounting heights shall be coordinated with the Architect on the jobsite, and with shop drawings of equipment; including equipment to be furnished and installed by the Owner. Devices installed in walls covered with vinyl, fabric wallpaper or other special finishes shall be coordinated and verified with the Architect on the job site.

F. Stranded wire termination to switches, receptacles, devices and miscellaneous control devices shall be with an approved solderless terminal if clamp type securing is not possible (i.e. Sta-Con crimp on fork tongue connectors; Burndy Type TP-F).

G. Provide keyed switches in all common areas not monitored by the faculty (i.e. gym, corridors, cafeteria, commons natatoriums).

H. All 15 amp and 20 amp receptacles shall be tamper-resistant type.

I. All 20A, 120V receptacles in food service areas shall be GFCI.

J. Provide GFCI circuit breakers for all drinking fountain branch circuits where GFCI receptacles are not indicated on plan.

K. Provide ARC Fault circuit interrupters (AFCI) as required to comply with article 210.12 of NFPA 70. This shall include but not be limited to dwelling units and dormitories. AFCI breakers may be used.

L. Provide ground fault circuit interrupter (GFCI)/ARC Fault circuit interrupter (AFCI) dual function receptacles to comply with articles 210.8, 210.12 and 406.4 of NFPA 70.

M. Contractor shall indicate the circuit serving each wiring device. Provide a typewritten label located on the inside face of the coverplate for all recessed mounted devices and on the outside of the coverplate on all surface mounted devices.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SCOPE

A. Provide fuses as shown and scheduled and indicate by this specification section and other specifications sections.

B. The type of fuses include:
   01 600 volt current limiting.
   02 250 volt current limiting.

1.2 STANDARDS

A. ANSI

B. UL

1.3 ACCEPTABLE MANUFACTURERS

A. Eaton Bussmann

B. Mersen

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of all fuses showing ratings and fuse curves.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   01 National Electrical Code.
   02 Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CURRENT - LIMITING FUSES

A. General: Provide 200,000 amp interrupting capacity current limiting fuses of the ampacity and voltage indicated and scheduled.

B. Mains, Feeders and Branch Circuits
   01 Circuits 601 to 6000 ampere shall be protected by current limiting BUSSMANN HI-CAP Time Delay Fuses KRP-C. Fuses shall employ "O" ring as positive seals between the end bells and the glass melamine fuse barrel. The terminals shall be peened. Fuses shall be time-delay and must hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in .1 seconds or less and be listed by Underwriters` Laboratories Inc., with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class L.

C. Class J Fuses

01 Circuits 0 to 600 ampere shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses LPJ. All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284 degree Fahrenheit melting point alloy and shall be independent of the short-circuited clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and listed by Underwriters' Laboratories Inc., with an interrupting rating of 200,000 amperes rRMS symmetrical. The fuses shall be UL Class J.

02 Motor Circuits - All individual motor circuits rated 600 amperes or less shall be protected by BUSSMANN LOW-PEAK LPJ. The fuses for 1.15 service factor motors shall be installed in ratings approximately 125% of motor full current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the motor full load current. Larger H.P. Motor shall be protected by BUSSMANN Type KRP-C HI-CAP Time-Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPJ installed in ratings approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class LPJ or L. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual-Element LPJ as shown on the drawings. The fuses shall be UL Class J.

2.2 SPARES

A. Upon completion of the building the contractor shall provide the owner with spare fuses as shown below.

01 10% (minimum of 3) of each type and rating of installed fuses shall be supplied as spares.

02 BUSSMANN spare fuse cabinets - Catalog No. SFC - shall be provided to store the above spares.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fuses: Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job-site or from installation. All fuses shall be furnished and installed by the electrical contractor. All fuses shall be of the same manufacturer.

B. All fuses shall be installed in fuse holders.

END OF SECTION

SECTION 26 28 16

SAFETY AND DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. Provide safety and disconnect switches as shown, scheduled and as specified herein.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.
   01 NEMA KS1 - Enclosed switches
   02 Federal specification W-S-865C-Heavy duty switches

B. Products shall conform all applicable UL standards, including UL98 (standard for safety, enclosed and dead front switches) and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   01 General Electric Company/ABB
   02 Square D Company
   03 Siemens
   04 Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of switches with ratings, physical dimensions and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   01 National Electrical Code.
   02 Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install heavy duty type safety switches with the number of switched poles as indicated on the plans and specifications. All safety switches shall be NEMA Heavy Duty Type HD, and Underwriters Laboratories listed.

2.2 MATERIALS AND COMPONENTS

A. Switch Interior

01 All switches shall have switch blades that are fully visible in the "OFF" position when the door is open. Switches shall have removable arc suppressor where necessary, to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60ºC and 75ºC copper or aluminum cables. All switches blades and contacts shall be plated copper. Adjust fuse block to accept Class J fuses.

B. Switch Mechanism

01 Switches shall have a quick-make and quick-break operating handle and mechanism, which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for locking in the "OFF" position with at least three padlocks. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. A means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Handle position shall indicate if switch is "ON" or "OFF".

C. Neutral

01 Provide a solid neutral with the safety switch where a neutral is present in the circuit.

D. Ratings

01 Switches shall be horsepower rated for ac and/or dc as indicated by the plans. The fused switches shall have Class R rejection fuse clips or adjusted for Class J fuses. UL listed short circuit ratings of the switches, when equipped with Class R fuses, shall be 200,000 symmetrical amperes.

E. Enclosures

01 Indoor switches shall be furnished in NEMA 1 enclosures.
02 Outdoor switches, switches located in wet areas or sprinkled areas shall be furnished in NEMA 3R enclosures.
03 Switches installed in wet areas such as cooling tower areas shall be NEMA 4X stainless steel or fiberglass reinforced polyester.
04 Switches installed in kitchens shall be stainless steel.
05 Switches installed in areas of a corrosive nature and subjected to salt air shall be NEMA 4X stainless steel or fiberglass reinforced polyester.

F. Electrical Interlock Contacts

01 Provide electrical interlock contacts on all disconnect switches serving motors in which remote VFDs are serving the motor. Provide conductors from contacts to the safe circuit inside the VFD. De-energizing the disconnect switch shall signal VFD to stop.

G. Service Entrance

01 Switch shall be suitable for use as service entrance equipment when installed in accordance with the National Electrical Code.

PART 3 - EXECUTION

3.1 GENERAL

A. Install safety and disconnect switches, including electrical connections, and fuses in accordance with manufacturer’s written instructions, NEC and recognized industry practices.

B. Location: Install switches within sight of controllers.

C. Hubs: Provide bolt-on hubs for rainproof or wet area applications.

3.2 IDENTIFICATION

A. Nameplate: Each disconnect switch shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show equipment served. Nameplates shall be attached with stainless steel screws.

END OF SECTION

SECTION 26 29 01

MOTORS AND STARTERS

PART 1 - GENERAL

1.1 SCOPE

A. Provide manual motor starters as shown, scheduled and as specified herein.

B. All integral motor starters furnished under Division 23 requirements shall be installed under Division 26 requirements unless noted otherwise on the plans.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.

B. Products shall conform to all applicable UL standards and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   01 General Electric Company/ABB
   02 Square D Company
   03 Siemens
   04 Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of all enclosures, switches, overloads, ratings, and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   01 National Electrical Code.
   02 Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. GENERAL: Refer to the Drawings for starter requirements for each motor.

2.2 MANUAL MOTOR STARTERS

A. GENERAL: Manual starters shall consist of a manually operated toggle switch equipped with melting alloy type thermal overload relay. Thermal unit shall be of one-piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed. Contacts shall be double break, silver alloy, visible from both sides of starter. Manual starters shall be square "D" class 2510 or 2512 or approved equal. Provide the size and number of poles shall be as shown and required by equipment served. Furnish red pilot light as indicated.

B. ENCLOSURES: All manual motor starter enclosures shall be NEMA 1, general purpose enclosures, unless shown otherwise. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTORS

A. GENERAL: Mount electric motors which are not factory installed.

B. MOTOR CONNECTIONS: Provide electrical and grounding connections to motors as indicated. Connections as follows:

01 Not less than 18 inch length of Sealtite, extending from motor connection box to motor branch circuit conduit on outdoor and wet locations. Provide Greenfield for inside dry locations.

02 Install connections mechanically secure, assuring electrical continuity, proper and effective grounding.

C. INSTALLATION OF MOTOR STARTER

01 Install motor starters in accordance with the manufacturer`s written instructions, the applicable requirements of the NEC and the NECA`s "Standard of Installation", and recognized industry practices to ensure that products serve the intended function.

02 Combination starter disconnects and starters mounted in ceiling plenums shall be installed 18” above ceiling grid.

END OF SECTION

SECTION 26 29 26

MISCELLANEOUS ELECTRICAL CONTROLS AND WIRING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. Provide the various miscellaneous control devices, wiring and additional branch circuits as required, shown and specified.

B. The types of miscellaneous control devices and wiring include but not limited to the following.
   01 Contactors
   02 Relays
   03 Photocells
   04 Time switches
   05 Relay Panels
   06 Additional control wiring and safety devices as shown and specified
   07 Connect power from fire alarm relays to starters to shut down air handling units
   08 Motorized Dampers
   09 Smoke Dampers and Combination Fire/Smoke Dampers

C. WORK SPECIFIED ELSEWHERE:
   01 Various control devices, of an electrical nature, for the safe operation and temperature control of the heating, ventilating, air conditioning and plumbing systems provided under Division 22 and Division 23.
   02 All control wiring and conduit shall be furnished under Division 23. All power wiring 120 volt or larger shall be provided by Division 26.
   03 Refer to building controls specification, Division 23 for scope of work required to be performed by Division 26 (electrical contractor).
   04 Specification 26 05 19 - Wire, Cable and Related Materials.

1.3 REFERENCE STANDARDS

A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

D. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

E. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
   01 NFPA 70
   02 Local municipal or state codes that have jurisdiction.
   03 UL 916
   04 UL 924

1.5 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   01 LIGHTING CONTACTORS AND RELAYS
      a. General Electric Company/ABB
      b. Automatic Switch Company
      c. Eaton
      d. Siemens
   02 PHOTOCELLS AND TIME SWITCHES
      a. Tork, Inc.
      b. Intermatic time controls
   03 RELAY PANELS
      a. Wattstopper
         1) LMCP
      b. Cooper/Eaton
         1) ControlKeeper

PART 2 - PRODUCTS

2.1 MATERIAL

A. GENERAL: This Section shall outline the basic installation of electric devices, conduit, boxes, fittings, and wiring required for complete interconnection of several systems, this may not reflect every required appurtenance. It does not cover integral parts of mechanical equipment.

B. CONTACTORS AND RELAYS: Provide control wiring, contactors, and relays with the ampere-rating and number of poles as shown, specified, and required for a complete and functioning system:
   01 Rated at 600 volts, 60 hertz.
   02 Continuously rated contacts for all types of ballast and tungsten lighting, resistance and motor loads. Contacts shall be sized as scheduled or noted.
   03 Shall have totally enclosed, double-break silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. Contact inspection and replacement shall be possible without disturbing line or load wiring.
   04 The contactor shall have straight-through wiring with all terminals clearly marked.
   05 The contactor shall be approved per UL 508 and/or CSA, and be designed in accordance with NEMA ICS 2-21 1B.
   06 They shall be industrial-duty rated for applications to 600 volts maximum.
   07 The contactor shall have provisions for factory or field addition of:
      a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
      b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
   08 The contactor shall have a NEMA type 1 enclosure unless otherwise noted.

09 Control power to the contactor 120V control circuit shall be provided from the nearest panelboard 120V circuit. If the 120V control power circuit is not shown, provide a control power transformer for 120 volt control power and a 120 volt coil when required for control. Provide primary and secondary fuses on the control power transformer.

10 Electrically Held Lighting - Contactor coils shall be continuously rated and encapsulated. Electrically held contactors are not to be used unless specifically shown on the plans.

11 Mechanically Held Lighting Contactors - Coil-clearing contacts shall be supplied so that the contactor coils shall be energized only during the instance of operation. Both latch and unlatch coils shall be encapsulated. All contactors shall be mechanically held unless noted otherwise on the plans.

12 Provide 2-wire or 3-wire control modules as required to operate lighting contactors.

13 Provide hand-off-automatic controls (H-O-A) for each lighting contactor.

14 Provide relays and contactors to shut down air handling units.

C. Photocells for Stand-alone controls (not part of relay panel controls): Provide a specification grade self-contained, weatherproof, photoelectric control that shall be mounted on an FS type weatherproof junction box. The photocell shall:

01 Switch "ON" at dusk and "OFF" at dawn.

02 Adjustable from 2 to 50 foot-candles.

03 Rated at 2,000 watts.

04 Use 1" diameter cadmium sulphide cell.

05 Have a 2-minute delay to prevent false switching.

D. TIME SWITCHES: Provide a 7-day digital time clock with battery back-up feature installed in a NEMA 3R enclosure.

E. Control wiring shall be not less than #14 AWG type THWN/THHN and shall be color coded and labeled with Brady markers throughout. Bundle multiple conductors with Ty-Raps.

F. Relay Panels

01 Rated 277V, 60Hz.

02 Panel operating voltage of 120-277V

03 Uses any of the following relays:

a. Mechanically Latching Relays

b. Multi-pole Relays

04 15A, 20A, and 30A rated relays available

05 Basic Capabilities:

a. 7-Day Clock

b. Capable of being set for 7 different day types per week

c. Includes automatic holiday shutoff feature

d. Has program backup to restore operations after power failure

e. Can be expanded to include override switches

f. On-board programming and processing

06 Each individual relay can be individually or group programmable to operate based on user-provided parameters, manual switch operation, photocells and sensors, or automatic program routines.

07 Rated for minimum of 10 million operations.

08 Contains occupant warning features to flash relays prior to time-out to notify occupants of change of state.

09 Capable of interfacing with other systems via RS-232, RS-485, or Ethernet.

10 Capable of interfacing with occupancy sensors for zone control.

11 Capable of Switch-Masking or Lockout features for user-operated switches.

12 Provide Locking Hinged Enclosures as suitable for relay panel environment. At a minimum, all relay panels shall be NEMA 1, and may be included with the relay panel assembly from the manufacturer. Provide enclosures to house relay panels where NEMA 1 is insufficient, as follows:
   a. Outdoors and unconditioned spaces: NEMA 3R
   b. Central Plants, or any plant with process water systems: NEMA 4/12
   c. Outdoors, Within 50-miles of saltwater coastlines: NEMA 4X

13 Dimming Modules shall be furnished with each relay panel, where dimming is required, per plan.

14 Pushbutton switches manufactured as compatible with the relay panel to either be used as override switches, or general control switches.

15 Provide photocells for use by relay panels for exterior ambient light monitoring:
   a. 1 per relay panel, when relay panels are stand alone
   b. 1 per building, when relay panels are networked

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install miscellaneous electrical controls and wiring to provide a functioning system.

B. Install contactor and relays in electrical/mechanical rooms unless otherwise noted.

C. Install photocells on the roof unless otherwise directed by the architect. Coordinate any roof penetrations with all other trades and shield from other light sources. Install photocells high on North facing walls, or in accordance with manufacturer's installation instructions.

D. Provide miscellaneous connections including disconnect switches for signs and other furnished equipment as shown on the Drawings.

E. Provide NEMA 3R/4/4X/12 enclosures where located outside.

F. Provide low-voltage cabling between relay panels and all control devices. Cabling shall be furnished by contractor as required by panel manufacturer, including Cat5, Cat6, Belden, dimming pairs, or other as required by the manufacturer. Pre-terminated cabling by manufacturer is acceptable.

G. All Low-Voltage cabling, for all systems, shall be neatly routed using J-Hooks. Cabling is installed above a hard ceiling, conduit shall be used to traverse the hard-ceiling segments.

3.2 DIVISION 22, 23, 27 AND 28 MISCELLANEOUS POWER AND CONTROLS

A. Install electrical devices not an integral part of system equipment providing conduit, boxes, fittings, wiring, circuit breakers, disconnecting means and other devices.

B. Contractor is responsible for providing all line voltage power to devices that require electrical power to operate. This shall include but not be limited to motorized dampers, smoke dampers, combination fire/smoke dampers, motorized gates, overhead rolling doors, and building control panels. Contractor shall terminate line voltage power to termination points. Contractor shall coordinate between all trades to determine sizing and quantities of line voltage circuits to adequately power and control devices. Provide circuits from nearest low voltage panel using spare circuits provided, if device requires power not already available or indicated.

C. Provide GFCI receptacle with weather proof cover within 25 feet of all heating, air conditioning and refrigeration equipment per NFPA 70.

3.3 OPERATIONS PERSONNEL TRAINING

A. All relay panels require manufacturer technician time to meet with owner, set programming conditions, time of day operations, and ensure owner-intended operations are met, based on whichever is most appropriate based on project size:
   01 8-Hours per relay panel
   02 The amount of time required to successfully meet the criteria of this section and result in a fully working system, accepted by the Owner.

B. A one-time recommissioning site visit, 4 Hours in time, by a manufacturer technician anytime between 90 and 120 days of building occupancy to adjust and reprogram (as required) the system based on owner input. This meeting shall be scheduled by the manufacturer and can only be declined by the owner.

C. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

END OF SECTION

SECTION 26 41 13.13

LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 GENERAL

A. The General Conditions, Supplementary General Conditions, Division 1 and the Section entitled "Electrical Work - General Requirements" apply to all work herein.

B. Objective: To provide safety for the building and occupants by preventing damage to building structure caused by lightning.

1.2 REFERENCE STANDARDS

A. Comply with these following specifications and standards of the latest issue form a part of this specification:
   01 Lightning Protection Institute Installation Standard, LPI-175
   02 Underwriters Laboratories, Inc. Installation Requirements, UL 96A
   03 National Electrical Code (NEC), NFPA 70
   04 National Fire Protection Association Installation Standard, NFPA 780
   05 U.S. Bureau of Standards

1.3 SCOPE

A. The work covered in this section of the specifications consists of providing all labor, materials, and items of service required for a complete lightning protection system. Provide Class I materials for roof levels less than 75 feet and Class II for roof levels 75 feet or greater.

B. If any departure from the Contract Drawings or submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practical to the engineer for approval.

1.4 QUALITY ASSURANCE

A. The lightning protection system shall conform to the requirements and standards for lightning protection systems of the LPI, UL, NFPA and NEC. Upon completion, application shall be made to the Underwriters Laboratories, Inc. for inspection and certification.

B. The system to be furnished under this specification shall be the standard product of manufacturers regularly engaged in the production of lightning protection equipment and shall be the manufacturer's latest approved design. The equipment shall be UL listed and properly UL labeled.

1.5 QUALIFIED MANUFACTURERS:

A. Robbins Lightning, Inc.

B. Advanced Lightning Technology

C. Thompson Lightning Protection

D. Harger Lightning Protection

E. East Coast Lightning Equipment

F. nVent ERICO

1.6 SUBMITTALS

A. Complete shop drawings showing the type, size and locations of all grounding, down conductors, through-wall assemblies, roof conductors and air terminals shall be submitted to the engineer for approval.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION EQUIPMENT

A. All materials shall be copper and bronze and of the size, weight and construction to suit the application and used in accordance with LPI, UL, NEC and NFPA. Class I sized components are required for roof levels not exceeding 75 feet in height Class II size components shall be required for roof levels over 75 feet in height. Bolt-type connectors and splicers shall be utilized on Class I and Class II structures. Pressure squeeze clamps are not acceptable. All mounting hardware on the roof shall be stainless steel and on the facade shall be brass and/or copper.

B. Aluminum Components - Aluminum materials may not be used except on roofs that utilize aluminum roofing components. The entire roof lightning protection system shall utilize aluminum components to insure compatibility on aluminum metal roofs or aluminum parapet caps. However, the downleads and grounding shall utilize copper with bimetal transition occurring at the through roof assembly with and approved bimetal through roof assembly. Copper is acceptable as a bimetal transition.

2.2 MATERIALS

A. All equipment used in this installation shall be UL listed and properly UL labeled. All equipment shall be new, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and LPI, UL, NFPA and NEC code requirements.

B. Air terminals shall be nickel-tipped copper, having a copper base. Air terminals shall be spaced not more than twenty feet apart. Provide flathead air terminals on the roof in areas where accidental implement may occur.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation shall be accomplished by an experienced installation company that is UL listed, a member of the Lightning Protection Institute, United Lightning Protection Association qualified, and an employer of Certified Master Installers of lightning protection systems. A Certified Master Installer shall directly supervise the work.

B. All equipment shall be installed in a neat, workmanlike manner. The system shall consist of a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper down leads and proper ground terminals.

C. Copper downlead cables shall be utilized.

D. Provide a ground test well at all ground rod locations.

E. Where conductors are run in metal conduit for protection, the conductor shall be bonded to the entrance and exit point of the conduit or approved methods to maintain electrical continuity.

F. Down conductors shall be attached to ground devices in accordance with the specific provisions of the Underwriters' Laboratories, Inc., Code. All-down conductors shall be concealed. Any exposed conductors shall be approved by Architect.

G. All metals of conductance within six feet of the lightning protection system shall be securely bonded and made a part thereof. Where stack or chimney is present, tinned covered non-corrosive air terminals and conductors shall be used. Metal water pipes shall be bonded to the grounding system.

3.2 COORDINATION

A. The lightning protection installer will work with any other trades present to insure a correct, neat and unobtrusive installation.

B. It shall be the responsibility of the lightning protection installer to assure a solid bond to the main water service and to assure interconnection with other ground systems.

3.3 COMPLETION

A. Upon completion of the installation, the lightning protection installer shall secure and deliver to the owner the Underwriters Laboratories, Inc. Master Label certification or the Lightning Protection Institute Certified System certification. The system will not be accepted without the UL Master Label plate or the LPI certification certificate.

END OF SECTION

SECTION 26 43 13.13

SURGE PROTECTIVE DEVICES (SPD) - STANDARD INTERRUPTING

LPART 1 - GENERAL

1.1 SCOPE

A. Specify the electrical and mechanical requirements for a non-modular high-energy surge protective device system (SPD). The specified system shall provide effective high energy surge current diversion and be suitable for application in IEEE C62.41.1 Category A, B and C3 environments, as tested by IEEE C62.11, IEEE C62.45.

B. The system shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to +/- 1-volt variance and tested for manufacturer's defects. The modules shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable. Devices shall utilize a minimum of three (3) MOV's fuse links pair per phase. This will allow greater than 50% redundant protection in if a MOV fails.

C. Third Party Test Report verifying surge current rating, longevity, testing, and filtering capabilities shall be provided with submittal.

1.2 STANDARDS

A. The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:
   01 Canadian Standards Association (CSA or CUL)
   02 American National Standards Institute and
   03 Institute of Electrical and Electronic Engineers (IEEE C62.11, IEEE C62.41.1, IEEE C62.41.2 and IEEE C62.45)
   04 Institute of Electrical and Electronic Engineers 1100 Emerald Book
   05 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
   06 National Electrical Manufacturer Association (NEMA LS-1 1992)
   07 National Fire Protection Association (NFPA 20, NFPA 70, NFPA 75 and NFPA 780)
   08 National Electric Code
   09 Underwriters Laboratories (UL 1449 and UL 1283)
   10 International Electrotechnical Commission (IEC 801)
   11 International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service
   12 EMC Directive 89/336/EEC - CE compliant

B. The systems individual units shall be UL/ANSI Listed and labeled under UL 1449 (Fourth Edition) Standard for Surge Protection Devices Type 2 20kA with a nominal discharge current of 20kA and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and labeled to UL 1283 for type 2 locations Standard for Electromagnetic Interference Filters, and CSA/CUL Listed.

1.3 ACCEPTABLE MANUFACTURERS

A. Southern Tier Technologies

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of surge protection devices with ratings, physical dimensions and all accessories clearly labeled.
   02 Device labels shall be clearly indicated in cutsheets.
   03 All standards and listings, as specified in section 1.2A-B, shall be clearly labeled in cutsheets provided.
   04 Cutsheets shall clearly outline that design requirements of this specification have been met.

1.5 QUALITY ASSURANCE

A. The manufacturer shall be ISO 9001 certified. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.

B. The unit shall be designed and manufactured in the USA by a qualified manufacturer of surge protection equipment and Active Tracking Filters. The manufacturer shall have been engaged in the design and manufacture of such products for a minimum of 10 years.

PART 2 - PRODUCTS

2.1 ENCLOSURE

A. The specified system shall be provided in a heavy duty NEMA 4 or better dust-tight, drip-tight enclosure with no ventilation openings.

2.2 OVERCURRENT PROTECTION (FUSING)

A. Individual surge components shall be fused to prevent violent failure. The fusing shall be UL listed and shall be capable of interrupting up to 200kA symmetrical fault current with 480VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable. Devices that utilize a single fuse to protect two or more suppression paths are not accepted.

2.3 DESIGN REQUIREMENTS

A. Protection Modes:
   01 The SPD shall provide protection as follows: All modes, L-N or L-L, L-G and N-G (where applicable) Note: L = Line, G = Ground, N = Neutral

B. UL 1449 Ratings:
   01 The maximum UL 1449 listed surge ratings for each and/or all of the specified protection modes shall not exceed the following in any mode of protection:

System Voltage	Voltage Protection Rating			
	L-N	L-L	N-G	L-L
120/240	600-volts	700-volts	700-volts	1200-volts
120/208	600-volts	700-volts	700-volts	1200-volts
240		1200-volts		1000-volts
277/480	1200-volts	1200-volts	1200-volts	1800-volts
480		1800-volts		1800-volts

C. Noise Attenuation:
   01 The unit shall be UL 1283 Listed as an electromagnetic interference filter in type 2 locations. The filter shall provide insertion loss with a maximum of 60 dB from 100 KHz to 100 MHz per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120 dB insertion loss from 100 KHz to 100 MHz when used in a coordinated facility system.

D. Life Cycle Testing:
   01 The SPD system shall be duty life cycle tested to survive 6,000 20kV, 10kA Surges, per IEEE C62.41.1 Category C3 surge current with less than 5% degradation of clamping voltage.

2.4 CONNECTIONS

A. Provide 60” wire leads #10 AWG or UL 1449 tested size.

2.5 STANDARD FEATURES

A. Unit Status Indicators:
   01 Red and green solid state indicators with printed labels shall be provided on the front cover to redundantly indicate on-line unit status including N-G monitoring. The absence of the green light and the presence of the red light shall reliably indicate that surge protection is reduced and service is needed to restore full operation.

B. Dry Contacts for remote monitoring:
   01 Electrically isolated Form C dry contacts, one normally open and one normally closed set standard on all units for remote monitoring.

C. Undervoltage detection:
   01 Unit shall be equipped with 70% undervoltage detection capability.

D. Phase Loss Monitoring:
   01 Unit shall be equipped with phase loss monitoring.

E. Power Loss Monitoring:
   01 Unit shall be equipped with power loss monitoring.

2.6 TESTING

A. Component Testing and Monitoring:
   01 Unit shall include an on-line circuit which tests and redundantly monitors individual components in all protection modes including neutral to ground (where applicable). Units that require external test sets or equipment are not acceptable.

2.7 ENVIRONMENTAL REQUIREMENTS

A. Storage Temperature: -55 to +85 C (-67 to +187 F)

B. Operating Temperature: -40 to +60 C (-40 to 140 F)

C. Relative Humidity: 0% to 95%

D. Audible Noise: less than 45 dBa at 5 feet (1.5 m).

E. Operating Altitude: 0 to 18,000 feet above sea level.

2.8 WARRANTY

A. The manufacturer shall provide a full 10 year parts and a 5 year labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL Listing requirements and any applicable national, state or local electrical codes. Direct, factory trained, ISO 9001 certified employees must be available for 48 hour assessment. A 24 hour 800 number must be available to support warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the parallel SPD with short and straight conductors as practically possible. Locate adjacent to the switchboard or panel it is serving. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. The contractor shall follow the SPD manufacturer's recommended installation practices as found in the installation, operation and maintenance manual and comply with all applicable codes. Provide STT Tierguide cable if the cable length exceeds 5 feet from the circuit breaker servicing the SPD.

B. Provide Flush Mount Stainless Steel Cover Kit for kitchen areas.

C. Provide Flush Mount Cover Kit for residential units and hotel suites.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICE (SPD) - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical and mechanical requirements for a modular high-energy surge protective device system (SPD). The system shall provide effective high energy surge current diversion and be suitable for application in IEEE C62.41.1 Category A, B and C3 environments, as tested by IEEE C62.11, IEEE C62.45.

B. The system shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to +/- 1-volt variance and tested for manufacturer's defects. The modules shall be designed and constructed in a manner that ensures surge current sharing. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable. Device shall utilize a minimum of three (3) MOV's fuse link pair per phase. This will allow redundant protection in the event that MOV's fail.

C. Third Party Test Report verifying surge current rating, longevity, testing, and filtering capabilities shall be provided with submittal.

1.2 STANDARDS

A. The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:
   01 Canadian Standards Association (CSA or CUL)
   02 American National Standards Institute and
   03 Institute of Electrical and Electronic Engineers (IEEE C62.11, IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45)
   04 Institute of Electrical and Electronic Engineers 1100 Emerald Book
   05 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
   06 National Electrical Manufacturer Association (NEMA LS-1 1992)
   07 National Fire Protection Association (NFPA 20, NFPA 75 and NFPA 780)
   08 National Electric Code (NFPA 70)
   09 Underwriters Laboratories (UL 1449 and UL 1283)
   10 International Electrotechnical Commission (IEC 801)
   11 International Standards Organization(ISO) Company certified ISO 9001 for manufacturing, design and service
   12 EMC Directive 89/336/EEC - CE compliant

B. The systems individual units shall be UL/ANSI Listed and labeled under UL 1449 (Fourth Edition) Standard for Surge Protection Device type 1 nominal discharge current of 20kA and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and CSA or CUL Listed.

1.3 ACCEPTABLE MANUFACTURERS

A. Southern Tier Technologies

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:
   01 Cutsheets of surge protection devices with ratings, physical dimensions and all accessories clearly labeled.
   02 Device labels shall be clearly indicated in cutsheets.
   03 All standards and listings, as specified in section 1.2A-B, shall be clearly labeled in cutsheets provided.
   04 Cutsheets shall clearly outline that design requirements of this specification have been met.

1.5 QUALITY ASSURANCE

A. The manufacturer shall be ISO 9001 certified. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.

B. The unit shall be designed and manufactured in the USA by a qualified manufacturer of line conditioning equipment and Active Tracking Filters. The manufacturer shall have been engaged in the design and manufacture of such products for a minimum of 10 years.

PART 2 - PRODUCTS

2.1 ENCLOSURE

A. The specified system shall be provided in a heavy duty NEMA 4 or better dust-tight, drip-tight enclosure with no ventilation openings. The cover of the enclosure shall be hinged on the left side and require a tool for access to internal components. A drawing pocket shall be provided inside the door for storage of unit drawings and installation/operation manual. All monitoring indication must be visible without opening the door. The enclosure maximum dimensions shall be (16) inches/(406) millimeters high, (16) inches/(406) millimeters wide and (8) inches/(203) millimeters deep.

2.2 OVERCURRENT PROTECTION (FUSING)

A. Individual surge components shall be fused to prevent violent failure. The fusing shall be UL listed and shall be capable of interrupting up to 200kA symmetrical fault current with 480VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable. Devices that utilize a single fuse to protect two or more suppression paths are not accepted.

2.3 DESIGN REQUIREMENTS

A. Protection Modes:
   01 The SPD shall provide protection as follows: All modes, L-N or L-L, L-G and N-G (where applicable) Note: L = Line, G = Ground, N = Neutral

B. UL 1449 Ratings:
   01 The maximum UL/ANSI 1449 listed surge ratings for each and/or all of the specified protection modes shall not exceed the following:

System Voltage	Voltage Protection Rating			
	L-N	L-G	N-G	L-L

120/240	700-volts	700-volts	700-volts	1200-volts
120/208	700-volts	700-volts	700-volts	1200-volts
240		1200-volts		1000-volts
277/480	1000-volts	1000-volts	1000-volts	1800-volts
480		1800-volts		1800-volts

C. Noise Attenuation:

01 The unit shall be UL 1283 Listed as an electromagnetic interference filter for type 2 locations. The filter shall provide 41dB at 100kHz, 31dB at 1MHz, 35dB at 10MHz, 53dB at 100MHz, per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120-dB insertion loss from 100 kHz to 100 MHz when used in a coordinated facility system.

D. Life Cycle Testing:

01 The SPD system shall be duty life cycle tested to survive, 10kA (8x20µs), 20kV (1.2x50µs), IEEE C62.41.1 Category C surge current with less than 5% degradation of clamping voltage. The minimum numbers of surges the unit shall be able to protect against are:

Model Surge Rating	Number of Life Cycle Surges			
	Per Mode			*Per Phase*
	L-N	L-G	N-G	L-N + L-G
250kA per phase	12000	12000	12000	24000
500kA per phase	24000	24000	24000	48000

2.4 CONNECTIONS

A. The terminals shall be provided to accommodate wire sizes up to #1/0 AWG.

2.5 INTERNAL CONNECTIONS AND SERVICEABILITY

A. All surge current diversion module intra-unit connections shall be by way of low impedance copper. Surge current diversion modules shall use bolted connections to the plates for reliable, low impedance connections. The system shall be designed for simple change out of any or all SPD component modules by a qualified electrician. Designs that require factory service are not acceptable. All connections, conductors and terminals must be appropriately sized for specified surge current capacity.

2.6 STANDARD FEATURES

A. Component Testing and Monitoring:

01 The monitoring circuitry must continually verify the protection status during operation, and display this information on the front cover status panel. The SPD must also contain a built-in-test circuit that will verify the integrity of all fuse links and each associated MOV. The built-in-test circuit must cycle through all phase banks and the neutral-ground bank sending test signals to all modules including N-G. The integrity of all fuses in test must be indicted on the status panel. All testing must be able to be performed without disconnecting power to the SPD. Units that require external test sets or equipment are unacceptable.

B. Unit Status Indicators:

01 Red and green solid state indicators with printed labels shall be provided on the hinged front cover to redundantly indicate on-line unit status. The absence of the green light and the presence of the red light shall reliably indicate that surge protection is reduced and service is needed to restore full operation.

C. Surge Counter:
   01 Provide up to 7-digit LED/LCD surge counter to total transient voltage surges.

D. Dry Contacts for remote monitoring:
   01 Electrically isolated Form C dry contacts, one normally open and one normally closed set standard on all units for remote monitoring.

E. Undervoltage detection:
   01 Unit shall be equipped with 70% undervoltage detection capability.

F. Phase Loss Monitoring:
   01 Unit shall be equipped with phase loss monitoring.

G. Power Loss Monitoring:
   01 Unit shall be equipped with power loss monitoring.

2.7 ENVIRONMENTAL REQUIREMENTS

A.	Storage Temperature:	-55 to +85 C (-67 to +187 F)
B.	Operating Temperature:	-40 to +60 C (-40 to 140 F)
C.	Relative Humidity:	0% to 95%
D.	Audible Noise:	less than 45 dBa at 5 feet (1 5 m)
E.	Operating Altitude:	0 to 18,000 feet above sea level

2.8 WARRANTY

A. The manufacturer shall provide a full 10 year parts and 5 year on site labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL Listing requirements and any applicable national, state or local electrical codes. Direct, factory trained, ISO 9001 certified employees must be available for 48-hour assessment. A 24 hour 800 number must be available to support warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall install the parallel SPD with short and straight conductors as practically possible. Locate adjacent to the switchboard or panel it is serving. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. The contractor shall follow the SPD manufacturer's recommended installation practices as found in the installation, operation and maintenance manual and comply with all applicable codes. Provide STT Tierguide cable low impedance cable when long lead lengths are needed.

END OF SECTION

SECTION 26 51 19

LIGHTING FIXTURES - LIGHT EMITTING DIODE (LED)

PART 1 - GENERAL

1.1 SCOPE

A. Provide general and emergency lighting fixtures as noted on the drawings. Fixtures shall be completely wired with lamps installed and shall be in perfect operating condition at the time of substantial completion.

B. The types of lighting fixtures required for this project include:
01 LED

1.2 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

C. NEMA JSC 10410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1012 - Safety Power Units Other Than Class 2; 2010.

F. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

G. NFPA 101

H. NEMA-LE

I. TM-21

J. LM-80

K. LM-79

L. L70

M. DLC

1.3 QUALITY ASSURANCE

A. All fixtures shall conform to all applicable UL standards and shall be UL label including damp and wet location ratings. “ETL listed” is an acceptable listing.

B. All LED drivers shall be UL recognized Class 2 per UL 1310 or non-Class 2 per UL 1012 as applicable.

C. All LED drivers shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR 15, for Non-Consumer Equipment.

D. All LED drivers shall be RoHS compliant.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide lighting fixtures produced by manufacturers as shown and scheduled.

B. LED DRIVER:
- 01 Provide one of the following manufacturers
  - a. Eldo
  - b. Lutron
  - c. Osram
  - d. Philips

C. LAMPS:
- 01 Provide one of the following LED Chip manufacturers
  - a. Cree
  - b. Nichia
  - c. North American Philips
  - d. Seoul
  - e. Lumileds

1.5 SUBMITTALS

A. Shop drawings shall include a brochure with a separate cut sheet for each fixture type arranged in alphabetical order with fixture and all accessories/options clearly labeled. Provide performance data for each fixture. Provide an independent test lab report for each fixture if requested by the Architect/Engineer.

B. Provide driver and LED module data brochures for each fixture type.

C. Provide air handling and heat removal data for light fixtures specified with these requirements.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:
- 01 National Electrical Code.
- 02 Local, municipal, or state codes that have jurisdiction.
- 03 UL fire resistance directory.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:
- 01 Provide the size, type and rating of each light fixture shown and scheduled. All light fixtures shall complete with reflectors, lens, trim rings, flanges, LED modules, lamp holders, drivers, fuses, wiring, earthquake clips, etc. to provide a complete functioning light fixture.

B. Lighting Fixture Types:
- 01 LED Fixtures

a. Fixtures shall be pre-wired with frame-in kit and integral thermal management system for fixtures. Driver shall be encased in metal-can construction for optimal thermal performance.
b. Total fixture lumen output is dependent on the chip, thermal management, driver current and optical system. LED fixtures shall be tested as a complete unit or system. Only DOE recognized CALiPER testing laboratory results shall be utilized.
c. Interior LED fixtures shall have integral common mode and differential mode surge protection of 3kV(1.2/50µs, 2 ohm combination wave).
d. Exterior LED fixtures shall have integral common mode and differential mode surge protection of 10kV/10kA(1.2/50µs, 2 ohm combination wave).

02 Exit signs
a. Exit signs shall meet all federal, state and local codes.
b. Provide fire alarm interface relay when required to flash exit signs.
c. Provide battery packs for emergency operation when not connected to emergency generator power.

2.2 LED MODULES AND DRIVERS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED
01 Driver manufacturer shall have a 10-year history producing electronic drivers for the North American market.
02 Driver shall carry a five year limited warranty from date of manufacture against defects in material or workmanship (including replacement) for operation at a maximum case temperature of 80 degrees Celsius.
03 Drivers shall not contain any Polychlorinated Biphenyl (PCB).
04 Provide driver with integral color-coded leads.
05 Driver shall operate from 50/60 Hz input source of 120 Volt through 277 Volt or 347 Volt through 480 Volt with sustained variations of +/- 10% (voltage) with no damage to the driver.
06 Driver output shall be regulated to +/- 5% across published load range. And shall have a power factor greater than .90 for primary application to 50% of full load rating with an input current Total Harmonic Distortion (THD) of less than 20% to 50% of full load rating.
07 Provide drivers with a Class A sound rating.
08 Provide LED drivers for outdoor fixtures with a minimum operating temperature of -40 degrees Celsius (-40 F). Provide LED drivers for indoor fixtures with a minimum operating temperature of -20 degrees Celsius (-2F).
09 Drivers shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
10 Driver output ripple current shall be less than 15% measured peak-to-average, with ripple frequency being greater than 100Hz.
11 Driver performance requirements shall be met when operated to 50% of full load rating.
12 Driver shall have integral thermal foldback to reduce driver power above rated case temperature to protect the driver if temperatures reach unacceptable levels.
13 Drivers shall comply with NEMA JSC 10410 for in-rush current limits.
14 Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller with dimming range controlled between 1 and 8VDC with source current 150µA.

2.3 LAMPS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED Lamps shall be appropriately matched to the driver with junction-down design for improved thermal management. Maximum DC Forward Current.

2.4 EMERGENCY LED BATTERY BACKUP

A. Provide Bodine #BSL310M for emergency light fixtures in 9 or 10-foot ceiling.

B. Provide Bodine #BSL20 for emergency LED driver for emergency light fixtures in ceiling heights greater than 12 feet.

C. Provide Bodine #BSL17-C2 for emergency LED driver for LED downlights.

D. Provide unswitched hot leg. Hot leg shall originate from the same branch circuit as required in article 700.12 (F) of NFPA 70.

2.5 POLES

A. Provide poles for area lighting fixtures as specified. Poles shall be one piece, anchor base, with 2-piece steel bolt cover and vibration dampers. Poles shall be round straight steel as specified on the Lighting Fixture Schedule.

B. Provide all poles with appropriate mounting accessories including arms, tenons, or bullhorns as required. Anchor bolts shall be hot dipped galvanized, sized as required by the manufacturer of the pole.

C. All poles shall have a normal 3” x 5” hand hole at 18” above the base flange and grounding provision.

D. Poles shall be prime painted interior and exterior. The exterior shall be finished with polyester powder coating and architectural finish as specified by the Architect. The interior with 3 mil thermoplastic hydrocarbon resin, or equivalent to meet 1000-hour salt spray exposure (ASTM B117).

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. General
   01 Install the type of lighting fixture where shown and indicated in accordance with manufacturer's written instructions.
   02 Provide earthquake clips on all recessed lay-in lighting fixtures as required by building code.
   03 Adjust all adjustable lighting fixtures, as directed by the Architect.
   04 Provide safety chains and wire guards for lighting fixtures located in gymnasium, multi-purpose rooms, play areas, etc.

B. Coordination
   01 The contractor shall verify the type of fixtures with the ceiling types as indicated on the drawings. Any discrepancies shall immediately be brought to the architect's attention before the contractor places his order and accepts delivery. Fixtures shall fit exact in the type of ceiling scheduled. Provide plaster frames, trim rings and other accessories required for a correct fit.
   02 Provide supports attached to structural member to support fixtures when the ceiling system cannot maintain support. Provide separate supports for all recessed ceiling mounted HID fixtures.
   03 Refer to architectural reflected ceiling plan for the exact location of all lighting fixtures. Notify the architect for any discrepancies or conflicts with structural, architectural, mechanical piping or ductwork before installation.

C. Mounting

01 Provide support channels to support outlet boxes used support surface mounted lighting fixtures such as exit signs or downlights.

02 Pendant or surface mounted fixture shall be provided with required mounting devices and accessories, including hickeys and stud-extensions, ball-aligners, canopies and stems. Locations of fixtures in mechanical areas shall be coordinated with mechanical contractor. Mounting stems of pendant fixtures shall be of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field. The allowable variation tolerance in mounting individual fixtures shall not exceed 1/4 inch and shall not vary more than 1/2 inch from the floor mounting height shown on the Drawings. Fixtures hung in continuous runs shall be installed absolutely level and in line with each other. Hanging devices shall comply with Code requirements. Fixtures shall employ single - not twin - stem hangers unless otherwise noted.

03 All structure mounted fixtures (i.e. bracket mounted, pipe mounted and surface mounted) shall be provided with cables of suitable size and weight to support the weight of the fixture. Cables shall be fastened around or fastened to the housing of the fixture. On pendant fixtures, one safety cable of suitable size and weight to support the weight of the fixture assembly shall connect the top of the pendant to the supporting structure by means of welding or bolting, and one safety cable shall connect the housing of the fixture to the bottom of the pendant. Where more than one pendant per fixture occurs, only one pendant must be cabled. Track fixtures for pendant mounted track shall also be supplied with clip-on safety cables of suitable size and weight to support the weight of the fixture.

04 Provide secondary support wires from all four (4) corners of the lay-in fixtures to the structure above. Do not support fixtures from ceiling grid wire supports, piping, conduit, side walls, or mechanical equipment. Ceiling specifications do not supersede this requirement.

05 Where pole mounted luminaries are provided, provide appropriate anchor base pole as specified with manufacturer's recommended anchor bolts. Verify exact location on site for poles with Architect, Civil, and Landscape documents. Poles shall be installed on proper footing. Refer to details on the drawings. Provide grounding connection to a separately driven ground rod, outside of the footing. Where indicated provide pole with identification plate indicating pole number.

06 Ground mounted flood type fixtures and flagpole lights, or similar fixtures, shall include stanchion and knuckle mount. Stanchion shall be supported by concrete base.

07 Flagpole mounted fixtures called out to be mounted on the flagpole shall be provided with tenon mount adapter and yoke.

D. Electrical Connection

01 All light fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit or MC cable fixture pigtails not exceeding 8'- 0". Provide #12 AWG conductors. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring of fixtures installed in accessible ceiling is not permitted. Fixture whips shall not lay-on ceiling tile or grid. Provide caddy clips to provide additional support.

E. Fire Rated Ceiling

01 Provide fire rated canopy or enclosure for all fixtures recessed in a fire rated ceiling. The fire rated canopy or enclosure shall be as required by the UL design number listed in the UL fire resistance directory. Refer to architectural drawing for the UL design number. Coordinate with ceiling installer and manufacturer. Provide proper rated drivers for lighting fixtures installed within these rated enclosures.

F. Air Handling Fixtures

01 Install all air handling light fixtures with return air slot in the open position, if it is to be as an air handling fixture. Coordinate with mechanical contractor.

3.2 FINAL INSPECTION

A. Remove all plastic and protective coating from all fixtures. Fixtures shall be thoroughly cleaned. Replace any damaged fixture or fixture parts including reflectors, louvers, lens and metal parts that show signs of corrosion.

B. Replace all other defective fixtures showing signs of excessive usage.

C. Demonstrate proper operation of all fixtures and controls. Refer to other sections and details on the drawings for lighting controls.

END OF SECTION

SECTION 26 56 68

EXTERIOR ATHLETIC LIGHTING

LIGHTING SYSTEM WITH LED LIGHT SOURCE

PART 1 - GENERAL

1.1 SCOPE

A. Provide sports athletic filed lighting for Tomball Independent School District.

B. Provide LED Lighting to illuminate the following venues:
01 Soccer

C.
01 Guaranteed Light Levels: Selection of appropriate light levels impacts the safety of players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 25 years.
02 Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to players, spectators, and neighbors.
03 Cost of Ownership: 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.
04 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 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.
a. Control and monitoring system shall provide contactor control of all existing circuits. Key switches shall be provided to provide field-level control of existing circuit groups.

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.

B. 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
Soccer/ Football	50 footcandles	2:1	72	30’ x 30’

Baseball	50 footcandles infield 30 footcandles outfield	2:1 infirld 2:5:1 outfield	25 infield 139 outfield	30’ x 30’
Softball	50 footcandles infield 30 footcandles outfield	2:1 infield 2.5:1 outfield	25 infield 71 outfield	20’ x 30’
Tennis	50 footcandles	2:1	120	20’ x 20’

C. Color Temperature: The lighting system shall have a minimum color temperature of <5700K and a CRI of <65.

D. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare onfield and providing sufficient uplight.

01 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.

02 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.

03 Aerial lighting – Adequate illumination must be provided above the field to see the ball in flight. It is recommended that a lighting analysis be performed above the field of play to evaluate the visibility of the ball over its typical trajectory to ensure the participants will adequately see the ball. Calculation planes should be evaluated up to the maximum anticipated height for the level of play.

04 Mounting Heights: To ensure proper aiming angles, minimum mountings heights shall be as described below. Higher mounting heights may be necessary for luminaire with lesser glare control to meet field angle requirements of section 1.2.C.1.

# of Poles	**Pole Designation**	**Pole Height**
4	SL1 – SL4	80’

1.3 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers, and external shields. No symmetrical beam patterns are accepted.

B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet above grade.

	Average	Maximum
Soccer/ Football 150’ Specified Spill Line Horizontal Footcandles	0.01	0.04
Soccer / Football 150’ Specified Spill Line Max Vertical Footcandles	0.05	0.014
Soccer / Football 150’ Specified Spill Line Max Candela (taken at 5 ft above grade)	1501	4300

C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be provided in 30-foot intervals along the boundary line at 3 ft above grade.

D. Sample Photometry: The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years' experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

E. Field Verification: Lighting manufacturer shall supply field verification of environmental light control using a meter calibrated within the last 12 months:

F. Spill verification: Illumination levels shall be taken in accordance with IESNA RP-6-22. The light sensing surface of the light meter should be held 36 inches above the playing surface with the sensing surface horizontal (for horizontal readings) or vertically pointed at the brightest light bank (for max vertical readings)

1.4 REFERENCE STANDARDS

A. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2010.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

C. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel; 2021.

D. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.

E. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

F. UL 96A - Standard for Installation Requirements for Lightning Protection Systems; Current Edition, Including All Revisions.

1.5 COST OF OWNERSHIP

A. Manufacturer shall submit a 25-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

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Approved manufacturer: Musco

B. 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.

C. 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/A123M. 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.

D. System Description: Lighting system shall consist of the following:
   01 Galvanized steel poles and cross-arm assembly.
   02 Non-approved pole technology:
      a. Square static cast concrete poles will not be accepted.
      b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long-term performance concerns.
   03 Lighting systems shall use concrete foundations. See Section 2.4 for details.
      a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
      b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-enforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
   04 Manufacturer will supply all drivers and supporting electrical equipment.
      a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade 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 in the enclosure. Integral drivers are not allowed.
      b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
   05 Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
   06 All luminaires, visors, and cross-arm assemblies shall withstand 150 mile (241.4 kilometer)/h winds and maintain luminaire aiming alignment.
   07 Control cabinet to provide remote on-off control, monitoring, and entertainment features of the lighting system. See Section 2.3 for further details.
   08 Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
      a. Integrated grounding via concrete encased electrode grounding system.

b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780.The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

E. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:
   01 Electric power: 480 Volt, 3 Phase
   02 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 150.51.

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. 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, 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.

E. 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).

F. 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 status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS and Android 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.

01 Cumulative hours: shall be tracked to show the total hours used by the facility.

02 Report hours saved by using early off and push buttons by users.

G. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.

H. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

I. Entertainment Features: Control System shall store four (4) standard preprogrammed lighting effects per field with option for two (2) custom preprogrammed lighting scenes or effects. Programming will additionally include four (4) minutes of custom programming with lights synchronized to music supplied by customer. Shows shall be initiated by a manufacturer-provided touchscreen user interface on the control system network.

2.4 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 140 and exposure category II.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report by Terracon, dated August 14, 2024.

D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

A. It shall be the Contractor’s responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner’s approval / payment for additional costs associated with:

01 Providing engineered foundation embedment design by a registered engineer in the State of Texas for soils other than specified soil conditions.

02 Additional materials required to achieve alternate foundation.

03 Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 8-12 from receipt of approved submittals and receipt of complete order information.

3.3 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 Accountability
   01 Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as “guaranteed” on the illumination summary provided by the manufacturer.
   02 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.
   03 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, and offsite candela readings 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. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. 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 25 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.

END OF SECTION

SECTION 27 02 00

BASIC MATERIALS AND METHODS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect and Engineer for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect and Engineer.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all labor, material, tools, equipment and services necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Communications items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least seven (7) working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning Communications system shall be considered a part of the overall "Scope".

H. Coordinate with other contractors on items required for the proper functioning of communications system and indicated as provided by others, such as power, backboxes, conduits, sleeves, air conditioning, structural support, etc..

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. Div 1 and conditions of the contract

B. Div 26 Electrical

C. Div 28 Electronic Safety and Security

1.4 COOPERATION WITH TRADES:

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronics Engineers (IEEE).

G. American National Standards Institute (ANSI).

H. National Fire Protection Association (NFPA).

I. International Energy Conservation Code (IECC).

J. BICSI (Building Industry Consulting Services International)

K. Owner’s Design Guidelines and Construction Standards

L. Local, county, state and federal regulations and codes in effect as of date of installation.

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

01 Approximate location of communications outlets, devices, equipment cabinets, cable trays, conduits and sleeves, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such items and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

02 Communicate with the Architect and secure his approval of any location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of ceiling devices shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical, electrical, plumbing contractor may be required to allow adequate clearances for all building components. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 QUALITY ASSURANCE

A. Contractor shall have a complete working knowledge of the communications system being installed.

B. Contractor shall have installed similar-sized systems in at least ten (10) other projects in the last five (5) years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document.

C. Contractor and individual installation crew members shall be experienced and qualified to perform the work specified herein at time of bid submission. All onsite supervision personnel that will be assigned to this project shall be listed in the Pre-Installation Submittal.

01 80% shall have a minimum of three (3) years of experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid.

02 All installation team members must demonstrate knowledge and compliance with all applicable methods, standards, and codes.

03 All members of the Structured Cabling System installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and capable of an installation that falls under manufacturer's guidelines necessary to obtain the Manufacturer's System Assurance Warranty.

04 Any personnel substitutions shall be noted in writing to the Owner.

D. A BICSI RCDD shall supervise and approve all on-site structured cabling work as a recognized member of the Contractor's installation team.

E. Contractor shall obtain Communications system product manufacturer's certification if applicable.

F. Refer to General Conditions for other requirements.

1.9 CONTRACTOR REQUIREMENTS

A. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.

B. Contractor shall provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete communications cabling infrastructure system. Pay all required sales, gross receipts, and other taxes.

C. Insurance

01 The Contractor shall procure, submit for review, and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance.

02 The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.

D. Regulatory Requirements

01 Communications Contractor shall supply all city, county, and state telecommunication cabling permits required by Authority Having Jurisdiction (AHJ).

02 Communications Contractor shall be licensed and/or bonded as required for telecommunications/low voltage cabling systems.

E. Privacy and Confidentiality

01 The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.

02 Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.

F. Use of Subcontractors

01 Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired.

02 The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.

G. The Contractor’s designated Project Manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications, references, and drawings) to ensure a quality installation and attend project meetings with the telecommunication consultant, the Owner and others.

H. Coordination
   01 Coordinate installation work with other trades (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways.
   02 The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications components.
   03 Exchange information and agree on details of equipment arrangements and installation interfaces.
   04 Coordinate with electrical contractors and plan for the pathway routes used communications cabling to minimize cable lengths. Report any potential over distance cable runs for approval before pulling the cables.
   05 Record agreements with other trades and distribute record to other participants, Owner and telecommunication consultant.

1.10 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty-day (30) time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

01 A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

02 An index page with a listing of all data included in the Submittal.

03 A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

04 Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

05 Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

06 Identification of each item of material or equipment matching that indicated on the Drawings.

07 Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

B. Shop Drawings

01 Communications Contractor shall submit, for approval, floor plans that identify all device locations, device ID, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.

a. Communication Contractor shall notify A&E team of any cable routes that will exceed the permanent link distance limit and get approval before work to start. Without advance notice and approval from A&E team, the contractor shall be fully responsible for make corrections as needed to bring all installed cables within the distance limit.

02 Communications Contractor shall submit, for approval, diagrams that show communications room layouts, rack layouts (including wall and rack elevations), cabling riser and interconnection diagrams, etc.

03 Communications Contractor shall submit, for approval, labelling scheme for all communications devices and cabling components (faceplates, horizontal cables, riser cables, inter-building cables, racks, patch panels, etc.) installed.

04 The Contractor shall make any corrections as required by the Engineer and submit revised shop drawings to the team for approval.

05 Approval by the Engineer of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. Requests to deviate shall be submitted in writing to the Architect.

06 Drawings shall show the proposed firestop systems and locations, (stamped/embossed by the PE) to restore/maintain the designed fire rating of the building structure (walls, ceilings, floors, etc).

07 Shop drawings shall be developed in coordination with other trades (MEP, Architecture, Structural, etc.) to avoid any collision or conflict and to meet all industry standards best practices, codes and regulation requirements. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified

08 Additional coordination with other trade contractors may be required to allow adequate clearances and meet code requirements. All transitions, offsets and relocations as required by actual field conditions shall be performed by the contractor at no additional cost to the owner

C. Product Data Submittals

01 Communications Contractor shall submit catalogue cutsheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.

02 Communications Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.

03 Product information sheets for the proposed system test equipment to include certification of test equipment calibration. Installer is to use test equipment with a calibration date within one year of test date. Installer is to recalibrate and resubmit if necessary.

04 All data sheets shall be organized by specification sections and provided with table of contents. All products required shall be included in one submittal.

05 All product substitutions shall be submitted in advance for review and approval before being included in product submittal package.

06 Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

D. Structured Cabling System Warranty

01 The Communications Contractor shall submit appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty.

02 All subsequent work shall be in accordance with approved submittals. The Communications Contractor shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer's warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.

E. Qualifications

01 Communications Contractor shall submit a list of the Contractor's previous projects that demonstrate qualification for this project. This list shall include, but not be limited to:

a. At least ten (10) other projects in the last five (5) years
b. Name and location of project
c. Project contacts, email addresses, and phone numbers
d. Total square footage
e. Total number of cables/drops
f. Types of media

02 Communications Contractor shall submit an up-to-date and valid statement of qualifications for those assigned to perform the work specified herein at time of bid submission.

a. Communications Contractor Employees
b. Subcontractors

03 Manufacturer certifications for Contractor and installers.

F. Cable Testing Plan

01 The Contractor shall provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber components and accessories prior to beginning cable testing.

02 The following minimal items shall be submitted for review:

a. A testing plan that clearly describes procedures and methods.
b. Product data for test equipment.
c. Certifications and qualifications of all persons conducting the testing.
d. Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
e. Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.

G. Samples

01 For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials.

H. Refer to Division 1 for additional information on shop drawings and submittals.

I. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

J. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

K. Submittals shall be reviewed and returned to the Contractor with one of the following categories indicated:

01 REVIEWED: Contractor does not need to take further submittal action, shall include this submittal in the O&M manual, and verify with Architects and other parties (Owner, etc) reviewing the submittals that no other correction is required before placing orders and starting installations.

02 REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

03 and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

04 REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

05 CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

06 MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

L. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

M. Refer to each specification section for additional requirements.

1.14 COORDINATION DRAWINGS

A. Before submit shop drawings, Contractor shall prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

01 Indicate the proposed locations of communications conduits/sleeves, cable trays, equipment, cabinet and other materials. Include the following:

a. Wall and type locations.
b. Clearances from other building structure and MEP equipment.
c. Clearances for servicing and maintaining equipment and cabling, and space for equipment disassembly required for periodic maintenance.
d. Equipment connections and support details.
e. Exterior wall and foundation penetrations.
f. Fire-rated wall and floor penetrations.
g. Sizes and location of required concrete pads and bases.
h. Structural floor, wall and roof opening sizes and details.

02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: cable routing, equipment location, clearance, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:

01 Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

02 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

03 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

04 Servicing instructions and lubrication charts and schedules.

05 Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 27, include the following information for equipment items:

a. Identifying names, name tags designations and locations for all equipment.
b. Fault Current calculations and Coordination Study.
c. Reviewed shop drawing submittals with exceptions noted compliance letter.
d. Fabrication drawings.
e. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
f. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
g. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
h. Equipment name plate data.
i. Wiring diagrams.
j. Exploded parts views and parts lists for all equipment and devices.
k. Color coding charts for all painted equipment and conduit.
l. Location and listing of all spare parts and special keys and tools furnished to the Owner.
m. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

06 The Communications Contractor shall deliver the Installer's Extended Product Warranty and Manufacturer's signed System Assurance Warranty of installed cabling system to include all components that comprise the complete cabling system.

a. Delivery shall be completed within two (2) weeks of the time of final punch list review.

07 Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

08 Cable Testing Report Requirements

a. Submit certified test reports of Contractor-performed tests. Contractor shall submit the required Test Reports in the format and media specified, upon completion of testing the installed system.

09 The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.

10 Three (3) sets of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable designations.

11 Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination components. Include products furnished:

a. Manufacturer's name
b. Manufacturer's part numbers
c. Cable designations

d. Location and riser assignments
e. Product Data

12 The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.

13 Supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

1.16 RECORD DRAWINGS

A. Maintain a continuous record during the course of construction of all changes and deviations in the work from the contract drawings. Upon completion of the work, purchase a set of "Auto Positive Tracings" on vellum and make corrections as required to reflect the electrical systems as installed. Location and size of all conduit shall be accurately shown to dimension. Submit three prints of the tracings for approval. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. Record drawings shall be furnished in addition to shop drawings. Symbols on the Record drawings shall correspond to the identification symbols on the contract drawings and equipment identification plates and tags.

B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed device and cabling, and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

E. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

F. For all cables and devices served from a wall mounted equipemnt enclosure, provide printed as-built wiring diagram showing all the cable route and type, device IDs and locations, and brand and models of all system components inside the enclosure, and attach the wiring diagram to the interior face of the enclosure's front door.

G. When the option described in paragraph E., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS
DATE:

(NAME OF GENERAL CONTRACTOR)
BY:_____
(SIGNATURE)
(NAME OF SUBCONTRACTOR)
BY:_____
(SIGNATURE)

1.17 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 27.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4-hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 27 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

C. Structured System Warranty

01 The Contractor shall be a certified Manufacturer’s Value Added Reseller (VAR) and/or Authorized Installer and provide an end-to-end product warranty, adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.

02 Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.

03 Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.

a. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.

b. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the contract documents, and support all current and future network applications for a minimum of twenty (20) years.

04 System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

01 It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

02 If the client, Architect or Owner of the project requires electronic media for "record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

03 At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

1.22 PRE-INSTALLATION MEETINGS

A. Communications Contractor shall attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section. This venue is to ask and clarify questions in writing with consultant and/or project manager/Owner representative.

B. Agenda

01 Safety
02 Work to be performed
03 Scheduling
04 Coordination
05 Other topics as necessary

C. Attendance

01 Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.

02 All individuals who will serve in an on-site supervisory capacity, including project managers, site supervisors, and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation and testing of communications cables on the project.

1.23 CONTRACT ADMINISTRATION

A. The Engineer may perform site visits and provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.

B. Job Field Report outline:
   01 General: The general installation progress in relation to scheduled work made by the Contractor up to that date.
   02 Deficiencies and/or Items of Note: Documents observations of the cable installation that may require corrective action by the Contractor.

1.24 POST INSTALLATION MEETINGS

A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc.

B. Attendees shall include
   01 Communications Contractor
   02 Project Manager/Owner Representative
   03 General Contractor
   04 Communications Engineer.
   05 Other trades that the GC deems appropriate.

C. At this meeting the Communications Contractor shall present and explain all documentation.

D. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Communications Contractor and resubmitted within one (1) week of the meeting.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:
   01 Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
   02 Alternate equipment must be equal from the standpoint of materials, construction and performance.
   03 Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 GENERAL REQUIREMENTS

A. All materials and products used on this project shall be listed by Underwriters' Laboratories.

B. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

C. All material and equipment, as provided, should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products.
   01 All shall be typical commercial designs that comply with the requirements specified.
   02 All material and equipment shall be readily available through manufacturers and/or distributors.

D. Installer is to comply in every way with the requirements of local laws, ordinances, and rules, , the National Board of Fire Underwriters, and the National Electrical Code.

E. In the event of any conflicts between documents referenced herein and the contents of this specification, the Installer is to notify in writing to the Architect/Engineer of any such occurrences before the purchasing of any equipment, materials and/or installation by the Installer. The Architect/Engineer will notify the Installer of any actions required to resolve these conflicts.

F. No change in the plans or in the specifications is to be made without written instruction to do so from the Owner or Architect/Engineer.

G. Materials are to be installed in accordance with manufacturer's recommendations and best industry practices.

H. The Installer is to promptly correct all discrepancies and/or defects for which the Installer is responsible.
   01 The Installer is to maintain a set of working specifications and drawings on site at all times and to make this set available for inspection during site visits.

I. All materials are to be new and of the highest quality.

J. All products installed in the above ceiling space are to meet or exceed the Underwriters Laboratories (UL) fire rated cable insulation requirements and are to be Plenum rated.

K. The Installer is to seal ALL penetrations, conduits, sleeves, cable trays, etc., where cabling has been installed through rated walls/floors with Wiremold Flamestopper intumescent fire-stop system (or approved equivalent) where they pass through rated walls. The Installer is responsible for returning any and all penetrations through rated walls or floors made for communications cable to their pre-penetration rating.

L. All material used to dress cable bundles shall be applied loosely to allow the dressing material to slide around the bundle. Tension of dressing materials shall not deform the cable sheath. Dressing materials should be limited to the telecommunications rooms only. Cabling shall be placed unbundled in cable tray and/or j hooks in the above ceiling spaces. No bundling materials are to be used above ceiling. All j hooks installed shall include the corresponding clip provided by the hook manufacturer. Plastic cable ties will not be permitted.

M. Any discrepancy in the contract documents is to be remedied by the Installer providing and installing the newer, greater quality or quantity of the item or items in question.

N. Horizontal cabling is to have minimum ten (10) feet of service loop coiled and stored above the ladder rack in the telecommunication room.

O. Horizontal cabling is to have no less than twelve (12) and no more than eighteen (18) inches of maintenance loop coiled and stored as close to the entrance to the workstation outlet as possible.

P. Horizontal cabling is to have no less than six (6) and no more than twelve (12) inches of maintenance loop coiled and stored inside the back box at the workstation outlet.

Q. Horizontal cable lengths for individual links shall not exceed 90 m (295 ft) from the point of termination at the connector to the point of termination at the patch panel.

R. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

S. Provide nylon bushings for all conduit openings.

T. All horizontal cables not in a cable tray or conduit shall be supported at a maximum of 48 to 60 inch intervals. Cable support system is to be independent of supports for other trades. At no point shall cable(s) make contact with acoustic ceiling supports, grids, panels, electrical conduits, water pipes or HVAC ductwork or supports.

U. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the installer prior to final acceptance at no cost to the Owner.

V. Pair untwist at the termination shall not exceed 3.18mm.

W. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.

X. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
   01 Plaster Surfaces: Milcor Style K.
   02 Ceramic Tile Surfaces: Milcor Style M.
   03 Drywall Surfaces: Milcor Style DW.
   04 Install panels only in locations approved by the Architect.

2.4 FIRE STOPPING

A. Contractor shall restore the fire rating of penetrations to rated walls, ceiling, flooring after cable pulling. Fire stopping products shall be as follows:
   01 Hilti
   02 SpecSeal
   03 3M
   04 Owner approved alternate

2.5 IDENTIFICATION (LABELING) SYSTEM

A. Contractor shall label al communications system components installed. Labeling products shall be as follows:
   01 Brady (LAT-19-361-4)
   02 Dymo
   03 Hellerman-Tyton
   04 Owner approved alternate

2.6 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.7 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.8 PAINTING

A. All factory assembled equipment shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements
   01 Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

B. Established Dimensions
   01 Where field measurements cannot be made without delaying the work, coordinate with the General Contractor to establish dimensions.
   02 When approved in writing, proceed with fabricating units without field measurements.
   03 Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

C. Pre-installation inspection

01 The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.

02 Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.2 DEMOLITION AND REMODELING

A. Where only portions of the existing Communications system are to be modified as part of the renovation and addition project, devices related to or part of this system outside of the renovation area shall be kept in operations.

B. The Drawings do not show all demolition work required. The Contractor shall make himself familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.

C. Utility service outages required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two (2) weeks in order to schedule required outages. 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.

D. The contractor shall perform a preconstruction walk thru of the site to observe and test the existing systems for operation. The owner assumes that the system is 100% operational and functioning prior to the commencement of construction. If any portion of the system observed or tested to be non-functional or inoperable at the commencement of the project will be noted by the contractor. A written report will be generated by the contractor noting their findings and submitted to the project team for review and handling. The owner will determine if the items found to be non-functional are to be repaired by contractor or repaired by the owner. If this repair of the equipment found to be non-functional is to be added to the contractor’s scope of work the contract amount for the Work shall be adjusted accordingly.

E. Work Sequence and Timing. The Owner will cooperate with the Contractor; however, the following provisions must be observed:

01 During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.

02 A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors and Sub-subcontractors, and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

F. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing Local Area Network (LAN) and Wide Area Network (WAN) infrastructure and workstation outlets. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

G. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

H. All equipment and/or systems noted on the Drawings "To Be Removed" should be removed including, associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

I. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility; or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

J. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

K. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

L. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

M. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage which occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

N. When applicable, Include in the contract price all rerouting of existing backbone cabling, , etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing telecommunications rooms in areas scheduled to remain operational with a minimum of interruption.

O. All existing cabling, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

P. Cabling and equipment s serving technology and communications, etc., which is to remain but which is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

Q. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

R. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

S. Field verify measurements, and cabling arrangements are as shown on Drawings.

T. Verify that scheduled cabling and equipment serving only those abandoned devices to be demolished and removed in its entirety.

U. Demolition Drawings are based on casual field observation and existing Record Documents. Report discrepancies to Architect and Engineer before disturbing existing installation.

V. Beginning of demolition means that the contractor accepts existing conditions.

W. Demolish and extend existing communications work under provisions of Division 02 and this Section.

X. Remove, relocate, and extend existing systems to accommodate new construction.

Y. Remove abandoned cabling to source of origination point. Remove racks and other equipment as scheduled on the drawings.

Z. Remove exposed / abandoned cabling systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.

AA. Repair adjacent construction and finishes damaged during demolition and extension work.

BB. Maintain access to existing systems which remain active. Modify installation or provide access doors as appropriate.

CC. Extend existing systems using materials and methods compatible with existing systems, or as specified.

DD. Clean and repair existing materials and equipment which remain or are to be reused. The Contractor shall modify, remove, and/or 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 the property of the Owner and shall be delivered to such destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operating condition. The Contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

EE. 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 and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

FF. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

GG. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points 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 disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done 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 approval of the Owner as hereinbefore specified.

HH. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all electrical services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

II. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

JJ. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

3.3 INSTALLATION

A. General
   01 Contractor shall install work in accordance with specifications, drawings, manufacturer’s instructions and approved submittal data.

B. Allowable cable bend radius and pull tension:
   01 In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation.
   02 Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
   03 After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.

C. Pull Strings
   01 Provide pull strings in all new conduits, including all conduits with cable installed (trailer strings) as part of this contract.
   02 Data and video cables can be pulled in tandem with pull strings.
   03 The pull strings must move freely to prevent cable jacket/cable damage during pulls.

3.4 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.5 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of Communications work shall be concealed in walls, chases, under floors and above ceilings except:
   01 Where shown to be exposed.
   02 Where exposure is necessary to the proper function.

3.6 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by "3M" or approved equal.

3.7 LABELING

A. All communications system field devices, faceplates, cables, termination devices, equipment enclosures (racks, cabinets, wall mounted boxes, etc) shall be clearly labelled with printed labels showing the device/cable ID, type, and the origination and destination location for cables.

B. All labelling shall conform to Owner's labelling standard and industry standards. Submit labelling scheme as part of the shop drawing for review and approval before work to start.

C. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

D. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.

E. Provide transparent plastic label holders, and 4-pair marked colored labels.

F. In accordance with ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure":
   01 Install colored labels according to the type of field as per color code designations.
   02 Use “designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields”.

G. Pathway Labels and Labeling System
   01 Labeling system shall consist of a hand-held portable printer
   02 Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive. Label size shall be appropriate for the conduit size. Font size shall be legible from the finished floor.
   03 Inner duct: Polyethylene general-purpose tagging material attached using tie wraps.
   04 Junction boxes: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name. Font size shall be easily visible from the finished floor.
   05 All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.
   06 Identification
      a. All conduits, junction boxes, gutters, and pull boxes shall have machine-generated labels easily visible from the finished floor.
      b. Conduits shall be labeled with the word “communications” and the conduit’s origination room number and destination room number.
      c. The Contractor shall label conduit at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other sections.
      d. Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by contractor and submitted for approval.
      e. The Contractor shall label conduit sleeves at each wall and floor penetration.

3.8 FIRESTOPPING

A. Provide approved fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system.

B. Install and seal penetrations (conduit, sleeves, slots, chases) in fire-rated barriers created for communications infrastructure to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.

C. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.

D. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.

E. Using a “ring and string” method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner in writing. Code-compliant firestopping rules still apply.

F. Coordinate firestopping procedures and materials with General Contractor.

G. Sharing the pathway of other trades/utilities through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.

H. Provide and install removable, intumescent mechanical systems in floor chases for all openings greater than 0'-4".

I. Provide and install removable, intumescent, firestop bricks for all openings greater than 0'-4" where there are penetrations through walls.

J. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers' specifications.

K. Provide manufacturer recommended material for rated protection for any given barrier.

L. Laminate and permanently affix adjacent to chases the following information:
   01 Manufacturer of firestop system.
   02 Date of installation/repair.
   03 Part and model numbers of system and all components.
   04 Name and phone numbers of local distributor and manufacturer's corporate headquarters.

M. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.

N. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.

O. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

P. Develop training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

Q. Within the normal environment, the installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

R. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in structure cable system capacity.

S. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

3.9 TESTING CABLING SYSTEM

A. Upon completion of the installation of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.
   01 Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.
   02 Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.

03 Approved instruments, apparatus, services, and qualified personnel shall be utilized.
04 The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing parameters listed elsewhere), and documentation as specified below.
05 This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.

B. Non-Compliant Cabling
01 Testing that shows some or all pairs of a cable do not comply with specifications, without written approval by the Owner, shall be replaced at Contractor's expense (including respective connectors).
02 With the Owner's written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.
a. Testing is still required for non-compliant cabling.
b. The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground.
c. The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.

C. Failed Tests
01 If tests fail, Contractor shall correct as required to produce a legitimate passing test.
02 Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.
03 If the Contractor is found to have manipulated or falsified any failing test result to show a "PASS" for any reason (without written notice and prior approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.

D. Owner reserves the right to be present during any or all testing.

3.10 WALL MOUNTED EQUIPMENT

A. Install all wall mounted equipment in accordance with the National Electrical Code, industry standards and as shown on the drawings.

B. Unless noted otherwise, all wall mounted equipment that need to be accessed for operation or maintenance shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices(note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.11 CLEANING

A. The Contractor will clean all surfaces of equipment and devices prior to final acceptance by Owner.

3.12 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.13 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

01 At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.

02 All devices, equipment, equipment cabinets and enclosure shall be cleaned and in operating condition.

03 Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.

04 Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.

05 After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

3.14 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.

B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes grounding and bonding products, design requirements and installation for communications systems.

B. Related Sections
   01 Section 27 02 00 - Basic Materials and Methods for Communications Systems
   02 Section 27 05 28 - Pathways for Communications Systems
   03 Section 27 11 00 - Communications Room Fittings
   04 Section 27 15 00 - Communications Horizontal Cabling
   05 Section 27 13 00 - Communications Backbone Cabling
   06 Section 27 05 43 - Underground Ducts and Raceways for Communications Systems

1.2 REFERENCES

A. The publications referenced in Section 27 02 00 form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   01 Refer to Section 27 02 00.

D. Codes and Standards
   01 Refer to Section 27 02 00.

1.3 SYSTEM REQUIREMENTS

A. General
   01 All conductor wire, busbars and conduit shall be UL listed.
   02 The communications ground system shall be independent from all power grounding except for the connection to the building's electrical service main grounding electrode system.
   03 Power grounding and/or bonding shall not be allowed to interfere or provide any back feed or be a conductor to the separate communications ground system source or to any communications bonded materials or equipment.

B. Telecommunications Main Grounding Busbar (TMGB) and Bonding Conductor for Telecommunications (BCT)
   01 The main ground source feed for the Telecommunications Main Grounding Busbar (TMGB) in the MC (MDF) shall be an independent feed from the building's electrical service main grounding electrode system, known as the Bonding Conductor for Telecommunications (BCT).

02 The BCT shall be a stranded copper ground wire from the building ground system to the TMGB in the MC (MDF) sized at a minimum #4/0 unless otherwise sized by the Electrical Engineer of Record.

03 The BCT connections shall be low emission exothermic welds at the connecting ends.

C. Telecommunication Bonding Backbone (TBB) and Telecommunications Grounding Busbar (TGB)

01 The Telecommunication Bonding Backbone (TBB) originates at the TMGB and shall be extended from the TMGB within the MC (MDF) throughout the building along the same route as the telecommunications backbone pathways, to the Telecommunications Grounding Busbar(s) (TGBs) in each TR (IDF).

02 The minimum TBB conductor size between busbars shall be a stranded copper ground wire one (1) AWG size smaller than the Bonding Conductor for Telecommunications (BCT).

D. Grounding Equalizer (GE)

01 Whenever two or more TBBs are used in a multistory building, the TBBs shall be bonded together with a GE (by low emission exothermic welds) at the top floor and at a minimum of every third floor in between with a copper conductor equal to the gauge of the TBB.

E. TEBC and RBC

01 All cabinets and racks shall be connected by the Telecommunications Equipment Bonding Conductor (TEBC). The TEBC is a stranded copper #4 conductor from the TMGB/TGB extending along each row of racks within the room. Bond each rack with a Rack Bonding Conductor (RBC). The RBC is a stranded copper #6 conductor connected to the vertical rack bonding terminal. All connections shall be irreversible crimp connections. Route conductor so as to minimize the quantity of sweeping bends.

1.4 SUBMITTALS

A. Refer to Section 27 02 00.

1.5 QUALITY ASSURANCE

A. Refer to Section 27 02 00.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 27 02 00.

B. The Contractor shall ship on manufacturer`s standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:

B. Cable Manufacturers

01 Houston Wire and Cable Company

02 Okonite Company
03 General Cable
04 Pirelli Cable Corporation
05 Triangle Wire and Cable
06 Owner Approved Alternate

C. Electrical Service Entrance Bonding Conductor and Connector Manufacturers
01 Copperweld
02 Thomas & Betts
03 Blackburn
04 Owner Approved Alternate

D. Exothermic Connector Manufacturers
01 Erico Products (Cadweld)
02 Continental Industries (thermOweld)
03 Harger
04 Owner Approved Alternate

E. Crimp Connector Manufacturers
01 Thomas & Betts
02 FCI Burndy Electrical
03 O-Z/Gedney
04 Owner Approved Alternate

F. Telecommunication Grounding Busbars
01 Chatsworth
02 Panduit
03 Leviton
04 Owner Approved Alternate

G. Bonding Straps
01 Chatsworth
02 Harger
03 Brundy
04 Owner Approved Alternate

H. C-Type Compression Taps
01 Brundy
02 Harger
03 Owner Approved Alternate

I. Antioxidant Joint Compound
01 Chatsworth
02 Owner Approved Alternate

J. Labeling
01 Refer to Section 27 02 00.

K. Firestopping
01 Refer to Section 27 02 00.

2.2 MATERIALS

A. Communications Grounding Conductors: Copper American Wire Gauge (AWG) wire of the following sizes:

01 Bonding Conductor for Telecommunications (BCT): #4/0 (unless otherwise sized by the Electrical Engineer of Record)
02 Telecommunication Bonding Backbone (TBB): #3/0 (unless otherwise sized by the Electrical Engineer of Record)
03 Grounding Equalizer (GE): equal AWG as the TBB (unless otherwise sized by the Electrical Engineer of Record)
04 Telecommunications Equipment Bonding Conductor (TEBC): #4
05 Rack Bonding Conductor (RBC): #6

B. Grounding Connectors
01 Connectors shall be a copper alloy material and two-hole, double-crimp compression lug type at the connecting ends.

C. Telecommunications Main Ground Busbar (TMGB)
01 Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
02 Sized for the immediate requirements and allow for 25% growth.
03 The minimum dimensions shall be 0'-¼" thick X 0'-4" wide X 1'-8" long.
04 Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
05 ASTM-B187-C11000 Copper bar suitable for use with two-hole compression-type copper lugs.

D. Telecommunications Ground Busbar (TGB)
01 Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
02 Sized for the immediate requirements and allow for 25% growth.
03 The minimum dimensions shall be 0'-1/4" thick X 0'-4" wide X 0'-10" long.
04 Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
05 ASTM-B187-C11000 Copper bar suitable for use with two-hole compression type copper lugs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

3.2 PREPARATION

A. Refer to Section 27 02 00.

B. Copper and copper alloy connections should be cleaned prior to connection.

3.3 INSTALLATION

A. Refer to Section 27 02 00.

B. The Contractor shall install the work in accordance with the specifications, drawings, manufacturer's instructions and approved submittal data.

C. All work shall be supervised and reviewed by the Contractor's on-site RCDD.

D. Installation plans and Requests For Information (RFIs) shall be reviewed by the Contractor's RCDD.

E. General

01 Bonding and grounding procedures and components shall comply with ANSI/TIA-607-B "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications".

02 Bonding should be accomplished such that the bonding system is integrated and compliant with NEC specifications.

03 Bonding conductors shall be routed with minimum bends or changes in direction and should be made directly to the points being bonded.

04 Bonding connections should be made by using compression copper lugs. However, for parts of the ground electrode system that are subject to corrosion, must carry high currents reliably, or for locations that require minimum maintenance, connections are made with low emission exothermic welding (see NEC Article 250).

05 Make connections to dry surfaces only.

06 Remove paint, rust, oxides, scales, grease and dirt from surfaces before making connection.

07 Burnish clean a 0'-1" X 0'-1" area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt conductor and connector to burnished and compounded area. Ensure proper conductivity.

08 Route bonding conductor(s) the shortest distance between bonding contact points.

09 The ground-wire connecting ends shall have a minimum amount of insulation removed at the ground lug.

10 Do not connect ground wire in power cable assemblies to the telecommunications ground system.

11 All grounding and bonding conductors shall be copper and may be insulated. If bare-bonding conductors are used, isolate bonding conductors and prevent contact.

12 Antioxidant material shall be installed to separate dissimilar metals and prevent corrosion.

13 If multiple systems are involved (lightning protection systems, communications, radio and TV, CATV, etc.), those systems shall be bonded together to minimize potential differences between the systems, per NEC 250.94.

F. Telecommunication Bonding Conductors

01 Each telecommunications grounding and bonding conductor shall be labeled at each end detailing the function and room number of its opposite end. Labels shall be located on conductors as close as practicable to their point of termination in a readable position. Labels shall be nonmetallic and include the following text, "TELECOMMUNICATIONS GROUND - DO NOT REMOVE. IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER".

02 Furnish and install all required bonding material, hardware, and utilize tools manufactured for this purpose.

03 The connections of the BCT, TBB, GE, TEBC, and RBC shall be made using low emission exothermic welding or hydraulically crimped with a double crimp connector. Two-hole grounding lugs are preferred for connection to the grounding bus bars.

a. All low emission exothermic welding shall be by Division 26.

b. Coordinate with the building services personnel in occupied spaces to prevent the smoke from the exothermic weld process from potentially setting off smoke/fire alarms.

04 Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in a ferrous metallic conduit that exceeds 1m (3ft) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6AWG conductor, minimum.

05 The bonding conductors should be installed without splices.

a. Where splices are necessary, the number of splices should be minimized, be accessible, and be located within the telecommunications spaces.

b. Joined segments of a bonding conductor shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.

G. Equipment Cabinets and Racks

01 The busbar shall be installed at the base and back of each cabinet/rack for floor fed cabinets/racks.

02 The busbar shall be installed at the top and back of each cabinet/rack for top fed cabinets/racks.

03 Each cabinet and rack shall be provided with a minimum # 6 AWG ground wire.

04 Do not loop from cabinet/rack to cabinet/rack.

05 Each cabinet or rack bay against the wall shall be bottom/side ground fed from the wall.

a. Wall ground feeds/raceways to racks shall not be exposed on the walls.

b. Exception: Some cabinet or rack bays will require the ground to be fed from the ceiling raceway.

06 All ground raceways within each cabinet/rack or cabinet base and adjacent-ganged cabinet base shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.

H. Cable Runway, Cable Raceway and Support System Grounding

01 The Contractor shall provide communications cable tray and cable runway systems with a communications dedicated ground from the TGB.

02 All cable tray needs to be electrically continuous per NEC 250.96.

a. Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current plausibly to be imposed on them.

b. Any nonconductive paint, enamel, or similar coating shall be removed at the threads, contact points, and contact surfaces.

c. Grounding or bonding conductors shall be connected by fittings designed for that purpose to ensure adequate bonding.

03 The Contractor shall provide and install a #6 AWG ground wire to bond one end of each cable tray/runway system to the TGB.

04 For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to the nearest TGB with grounding bushings or ground clamps.

I. Shielded Backbone Cabling

01 The Contractor shall terminate and bond the shield to the nearest TGB or TMGB at both ends, following manufacturer's guidelines.

3.4 FIELD QUALITY CONTROL

A. Testing

01 Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc.

02 Approved instruments, apparatus, services, and qualified personnel shall be utilized.

03 If stray currents, shorts, etc., are detected, eliminate or correct as required.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   01 Hangers and Supports, including open-top supports (cable hooks) for communications systems.
   02 Conduits and Pull Boxes for communications systems.
   03 Cable Tray and Cable Runway with associated accessories and fittings for communications systems.

B. Related Sections
   01 Section 27 02 00 - Basic Materials and Methods for Communications Systems
   02 Section 27 05 26 - Grounding and Bonding for Communications Systems
   03 Section 27 11 00 - Communications Room Fittings
   04 Section 27 15 00 - Communications Horizontal Cabling
   05 Section 27 13 00 - Communications Backbone Cabling
   06 Section 27 05 43 - Underground Ducts and Raceways for Communications Systems

1.2 REFERENCES

A. The publications referenced in Section 27 02 00 form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   01 Refer to Section 27 02 00.

D. Codes and Standards
   01 Refer to Section 27 02 00.

1.3 SUBMITTALS

A. Refer to Section 27 02 00.

1.4 QUALITY ASSURANCE

A. Refer to Section 27 02 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 27 02 00.

B. Conduit Storage
   01 Package conduits in bundles maximum 10'-0" long, with conduit and coupling thread protectors for indoor/outdoor storage.

02 Package fittings in manufacturer`s standard quantities and packaging suitable for indoor storage.
03 Protect coating on plastic-coated rigid conduit, fittings, and bodies from damage during shipment and storage.
04 Store conduit above ground on horizontal racks to prevent corrosion and entrance of debris.
05 Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Protect plastic conduit and inner duct from sunlight. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:

B. Cable Hooks
01 Cooper B-Line, Inc.
02 Erico
03 Caddy
04 Owner approved alternate

C. Basket Type Cable Tray (for use in work areas)
01 Cooper B-Line, Inc.
02 Chatsworth (CPI)
03 Owner approved alternate

D. Wire Basket Cable Tray Cutting Tool
01 Cooper B-Line, Inc.
02 Chatsworth (CPI)
03 Owner approved alternate

E. Polyethylene Cable Support System
01 Erico
02 Owner approved alternate

F. Innerduct
01 Carlon Riser Guard Flexible Raceway (corrugated innerduct)
02 Owner approved alternate

G. Measured pull tape (pull tape printed with sequential footage markings)
01 Fibertek
02 Condux International
03 Owner approved alternate

H. Labeling
01 Refer to Section 27 02 00.

I. Firestopping
01 Refer to Section 27 02 00.

2.2 CABLE HOOKS

A. Cable hooks shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.

B. Features
   01 Cable hooks shall have a flat bottom and provide a minimum of 0'-1.625" cable-bearing surface.
   02 Cable hooks shall have 90° radius edges to prevent damage while installing cables.
   03 Cable hooks shall be designed so that the mounting hardware is recessed to prevent cable damage.
   04 Cable hooks for non-corrosive areas shall be pre-galvanized steel. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish.
   05 Cable hooks for corrosive areas shall be stainless steel.
   06 Cable hooks shall have a stainless steel cable latch retainer to provide containment of cables within the hook.
   07 The retainer shall be removable and reusable.

C. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

D. Load cable hooks in accordance with manufacturer requirements and recommendations.

E. Provide capacity for 25% growth, add additional hooks as needed.

2.3 PULL BOXES, JUNCTION BOXES, AND GUTTERS

A. All junction boxes, gutters and pull boxes shall be UL listed and comply with NEC requirements.

B. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
   01 16-gauge steel or heavier
   02 Seams shall be continuously welded and grounded smooth
   03 External screws and clamps
   04 External mounting feet (where applicable)
   05 Oil-resistant gasket and adhesive
   06 ANSI 61 gray polyester powder coating inside and out over phosphatized surface

C. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.

D. All junction boxes, gutters and pull boxes shall be securely installed.

2.4 CONDUITS

A. All conduits shall be UL listed and comply with NEC requirements.

B. Conduit Fittings
   01 All fittings shall be compression or threaded.
   02 Fittings shall provide a secure connection for pulling communications cables.
   03 Setscrew fittings are not permitted.
   04 Conduit "condulets" are not permitted.

C. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.

D. Innerduct:
   01 All fiber shall be installed in innerduct unless fiber cabling is armored.
   02 Shall be constructed of non-metallic material.

E. Only manufacturer's fittings, transition adapters, terminators and fixed bends shall be used.

F. Measured Pull Tape
   01 Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn with footage markers printed on the tape.
   02 Minimum average tensile strength shall be 1130 lbs. for 0'-1.5" and smaller conduits and innerduct.
   03 Minimum average tensile strength shall be 1800 lbs. for conduits larger than 0'-1.5".

G. Fill and Bend Radius
   01 Conduit fill shall comply with NEC requirements.
   02 The minimum bend radius is 6 X the conduit inside diameter (ID) for 0'-2" conduit or less.
   03 The minimum bend radius is 10 X the conduit ID for a conduit greater than 0'-2".
   04 There shall be no more than two 90° bends (180° total) between conduit pull boxes.
   05 Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above.
   06 Do not use pull boxes for direction changes unless specifically designated otherwise in the drawings.
   07 Unless otherwise noted in the drawings, conduits entering pull boxes shall be aligned with exiting conduits.

H. Routing
   01 Conduits shall be routed in the most direct route possible, with the fewest number of bends possible.
   02 There shall be no continuous conduit sections longer than 100'-0" for premises conduits. For runs that total more than 100'-0", insert junction or pull boxes so that no continuous run between pull boxes is greater than 100'-0".

I. Penetrations
   01 All conduit penetrations shall comply with all applicable fire codes.
   02 All conduit penetrations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the penetration area.

2.5 CABLE TRAY

A. Cable tray systems are defined to include, but are not limited to, straight sections of cable trays, bends, tees, elbows, reducers, crosses, wyes, vertical bends, up/down tees, cable support fittings, drop-outs, supports and accessories.

B. Install all tray types utilizing manufacturer recommended installation instructions and applicable standards.

C. Load cable tray and cable runway in accordance with manufacturer requirements and applicable standards.

D. Cable Tray Materials
   01 Aluminum

02 Pre-galvanized Steel
03 Hot-dip Galvanized Steel
04 Stainless Steel
05 Yellow Zinc Dichromate
06 Pre-Galvanized Zinc
07 Electro-Galvanized Zinc

E. Cable Tray Systems
01 Wire basket (mesh) of types and sizes indicated on the drawings; with connector assemblies, clamp assemblies, connector plates, splice plates, cable drop outs, bonding accessories, and splice bars. Construct units with rounded edges and smooth surfaces.
02 Continuous mesh polyethylene cable-support system: with connector assemblies and appropriate support components. All parts shall be UL-listed. Plastic (non-metallic) parts shall have a zero detectable halogen content as substantiated by an independent test laboratory.
03 Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 0`-9" on center. Spacing in radius fittings shall be 0'-9" as measured at the center of the tray`s width. Rungs shall have a minimum cable-bearing surface of 0'-.875" with radius edges. No portion of the rungs shall protrude below the bottom plane of the side rails.
04 Ventilated trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails.
05 Solid bottom trough type trays shall consist of two longitudinal members welded to the side rails.

F. Cable trays shall have sufficient depth and width so as not to exceed a maximum 50% fill ratio, including 25% capacity for anticipated growth.

G. All straight sections shall be supplied in minimum 8'-0" lengths, except where shorter lengths are permitted to facilitate tray assembly lengths.

2.6 HANGERS AND SUPPORT

A. Steel support brackets shall be galvanized steel and capable of supporting a minimum of 200 lbs with a safety factor of 3.

B. Steel support brackets shall have a removable galvanized steel retaining strap.

C. Steel support brackets shall accept 0'-3/8" (10mm) threaded rod for attachment to building structure or sub structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

3.2 PREPARATION

A. Refer to Section 27 02 00.

B. Verify system is properly sized for cables before installation.

C. Verify that the manufacturer recommended loads are not exceeded.

D. Verify general routing and coordinate locations with other trades before installation. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to ensure non-interference from other trade installations.

3.3 INSTALLATION

A. Refer to Section 27 02 00.

B. Cable Hooks
- 01 Provide cable hook (j-hook) cable support system for horizontal and/or riser cabling in accessible ceiling space. Assemblies shall be complete with mounting hardware.
- 02 Provide threaded rod for supporting hangers when hanging from floor deck and deck members.
- 03 Follow manufacturers fill capacities.
- 04 Locate cable hooks on 4’ to 5’ centers to adequately support and distribute the cable’s weight.
- 05 Suspended cables shall be installed with at least 0’-3” of clear vertical space above the ceiling tiles and support channels.
- 06 For larger quantities of cables, provide special supports that are specifically designed to support the required cable weight and volume.
- 07 Do not support pathways or cables with the ceiling suspension system or use electrical, plumbing, or other pipes for support.
- 08 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.
- 09 Secure and support exposed horizontal cable at intervals not exceeding 5’-0” and not less than 1’-4” (16”) from cabinets, pack pole, boxes, fittings, outlets, racks, frames, and terminals.
- 10 Cable sag between vertical supports for horizontal pathway shall not exceed 0’-6”. Provide at least 0’-3” cable sag between supports.
- 11 Painted J-hooks shall meet or exceed NEC requirements for the environment in which the product is installed.

C. Conduit and Pull Boxes
- 01 The Contractor shall route the conduit in approximate locations unless drawing is dimensioned for precise placement.
- 02 Conduit cuts shall be square. Ream ends of burrs, and remove metal shavings and cutting lubricants before conduit is connected to the conduit system.
- 03 For conduit embedded in concrete, coat threaded connections in conduits with colloidal rust and corrosion inhibitor and sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured.
- 04 Cap unused conduits with watertight caps
- 05 Make conduit connections with appropriate fittings and tighten securely.
- 06 Use appropriate tools to install PVC coated conduit; avoid damage to exterior coating.
- 07 Install liquid-tight flexible metal conduit where exposed to weather, water, or other liquids.
- 08 Use IMC, PVC conduit, or rigid galvanized steel conduit in underground installations.
- 09 The Contractor shall provide fabric innerduct in all underground conduits, as indicated on the drawings.
  - a. The Contractor shall use pre-lubricated, woven polyester, low friction, and high abrasion resistant fabric.

b. The Contractor shall be trained for proper installation technique by the innerduct manufacturer. The Contractor shall coordinate with the owner to demonstrate that pull ropes in each inner duct cell move freely from end to end.

D. Cable Tray and Cable Runway
01 Cut wire basket tray members square with approved cable tray cutting tool as to not leave sharp edges at cut point. Remove burrs and smooth the ends before the cut is connected to wire-mesh tray system.
02 Ensure that standard splices are designed to have less than 1 milliohm (0.0001 Ω) of resistance between connections and provide bonding between sections. Painted wire mesh tray requires the outer mask of the non-conductive surface be removed at each end of the tray prior to installing the splice to provide continuity between painted tray sections.
03 Threaded rod (minimum 0'-½" diameter) or equivalent and slotted channel shall be used for hanging cable tray between floor deck and deck members

E. Fiber Support:
01 Support vertical fiber optic cable with basket weave wire/cable grips. Support fiber riser with single weave support grip with a single offset eye.
02 Mount/attach pulling eye to a wall or ceiling deck secured hook to support/provide strain relief to riser cable. Provide a minimum 3'-0" loop of fiber prior to entering fire stopped floor sleeve.
03 Where required coil up slack fiber cable into pull box and secure with single weave support grip.

F. Clearances
01 A minimum of 1'-0" access headroom shall be provided above a cable tray. Ensure that other building components do not restrict access to the cable trays from the sides.
02 Power outlets shall not be installed in or mounted to cable tray or cable runway.
03 Provide 3'-0" of unencumbered space for every 10'-0" segment of tray.
04 Cable tray clearances
a. Motors or transformers: 4'-0"
b. Power cables and conduit: 1'-0"
c. Fluorescent lighting: 0'-5"
d. Halide lights: 1'-0"
e. Above the ceiling tiles: 0'-3"
f. Access above and on one side of the cable tray: 1'-0"

3.4 FIELD QUALITY CONTROL

A. Test system to ensure electrical continuity of bonding and grounding connections.

B. Ensure compliance with specified maximum ground resistance.

C. Refer to NFPA 70B Chapter 18 for testing and test methods.

3.5 CLEANING

A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.

B. Wipe clean all cable trays and apply appropriate manufacturer's paint to areas that have been scratched.

END OF SECTION

SECTION 27 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes underground communications duct banks, hand-holes and maintenance holes

B. Related Sections
- 01 Section 26 02 00 - Electrical (including related sub-sections)
- 02 Section 27 02 00 - Basic Materials and Methods for Communications Systems
- 03 Section 27 05 26 - Grounding and Bonding for Communications Systems
- 04 Section 27 05 28 - Pathways for Communications Systems
- 05 Section 27 11 00 - Communications Room Fittings
- 06 Section 27 13 00 - Communications Backbone Cabling

1.2 REFERENCES

A. Refer to section 27 02 00.

B. Conflicts
- 01 Refer to section 27 02 00.

C. Codes and Standards (Most recent editions or as required in contract)
- 01 National Electrical Manufacturers Association (NEMA)
  - a. RN1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Electrical metallic Tubing
  - b. TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
  - c. TC3 PVC Fittings for Use with Rigid PVC conduit and tubing
- 02 Underwriters Laboratories (UL)
  - a. UL 651 - Schedule 40 and 80 Rigid PVC conduit
  - b. UL 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit
- 03 ANSI/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces
- 04 ANSI/TIA-758-A Customer-owned Outside Plant Telecommunications Standard.
- 05 BICSI Telecommunications Distribution Methods Manual (TDMM)
- 06 Standard for Riser Application for Optical Fiber Raceway
- 07 BICSI Customer Owned Outside Plant (CO-OSP) Design Manual
- 08 Local, county, state and federal regulations and codes in effect as of date of installation
- 09 Equipment of foreign manufacture must meet U.S. codes and standards.
  - a. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.
- 10 IEEE C2, National Electrical Safety Code (NESC).

D. Related Documents
- 01 Refer to section 27 02 00.

1.3 SUBMITTALS

A. Refer to section 27 02 00.

1.4 QUALITY ASSURANCE

A. Refer to section 27 02 00, and IEEE C2.

B. Follow Annex B of National Electrical Code (NEC)

C. Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts, and components.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped.
   01 Store nonmetallic ducts with supports to prevent bending, warping, and deforming

B. The contractor shall endeavor to make the site ready for installation of manholes when delivered so that they can be placed off of the truck into final position.
   01 When this is not possible, store precast concrete and other factory-fabricate underground utility structures as Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

D. Clearly mark containers "For Communications Duct Banks Only".

E. Refer also to section 27 02 00.

1.6 WARRANTY

A. Refer to IEEE C2.

B. Refer also to section 27 02 00.

1.7 MAINTENANCE

A. Refer to IEEE C2.

B. Refer also to section 27 02 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Ducts
   01 Use owner approved solution

B. Hand Holes
   01 Christy Concrete Products
   02 Cretex Concrete Products West, Inc.; Riverton Division
   03 Oldcastle Precast Group
   04 Oldcastle Precast Inc/; Utility Vault Division
   05 Utility Concrete Products, LLC

06 Owner Approved equivalent

C. Maintenance (Man) Holes
01 Christy Concrete Products
02 Cretex Concrete Products West, Inc.; Riverton Division
03 Oldcastle Precast Group
04 Oldcastle Precast Inc/; Utility Vault Division
05 Utility Concrete Products, LLC
06 Owner Approved equivalent

2.2 MATERIALS

A. Continuous Tape for Underground Conduit
01 The Contractor shall use orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), three inches wide, permanently imprinted with "CAUTION--BURIED COMMUNICATIONS LINE BELOW" in black letters, minimum 0’-1” high.

B. Labeling
01 Refer to section 27 02 00.

C. Firestopping
01 Refer to section 27 02 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Where necessary, Contractor shall provide all excavation, boring, trenching, backfill and restoration of grounds for all OSP pathways.
01 In addition, Contractor shall include all labor, materials, and equipment.

B. The owner of the property has the option to obtain a testing laboratory to ensure proper soil compaction.

C. All work shall comply with all city, county and State Codes, NEC, EIA/TIA, OSHA, and BICSI TDMM requirements, codes and standards.

D. The above referenced codes and standards are to be considered as a minimum requirement.
01 If the plans or specifications call for material and/or methods of construction higher than the standard, the plans or specification shall govern.

E. All holes, trenches and/or any other excavation shall be covered, fenced, and/or taped off to make the area safe at all times.
01 Conform to general Contractor requirements.

F. The Contractor will visit the job site prior to submitting a proposal to determine existing conditions.
01 Contractor shall evaluate the site for materials, and any other information that may affect the work to be performed.

G. The Contractor shall locate and protect all existing conduits.
01 Should damage occur notify the appropriate utility.
02 Damage costs are the responsibility of the Contractor.

H. The Contractor shall CALL BEFORE YOU DIG, One Call Directory Telephone Numbers (Texas: 1-800-245-4545, 1-800-344-8377) to locate any existing conduits (Power, Gas, Telephone, and other utilities) prior to start of work.

I. Any proposed re-routing of all trenches/pole lines shall be reviewed and approved by the owner/consultant.

3.2 PREPARATION

A. Refer to Section 27 02 00.

B. The Contractor shall verify materials are on-site in proper condition and of sufficient quantity.

C. The Contractor shall verify proper excavation depth (minimum 4'-0" below finished grade), width, route and support of work.
   01 Verify proper location of hand-holes and maintenance holes (minimum every 350'-0").
   02 Communications facilities must be placed in separate hand-holes and maintenance holes from electrical facilities.

D. Trenches greater than or equal to 5'-0" deep shall:
   01 Be shored to prevent cave-in.
   02 Have 2'-0" clearance from the dirt pile.

E. Directional boring is a suitable option when trenching is impractical or impossible.
   01 Locating existing underground utilities is crucial when directional boring is planned because of the potential for the drilling unit to encounter high voltages.
   02 Although directional boring machines are manufactured with electrical strike sensing capabilities, which can warn the operator of any contact with a high voltage source, accidents may still occur.
   03 Operators of directional boring machines require special protection due to the potential for exposure to high voltage.
      a. Therefore, operators must always have a ground mat grid underfoot as insulation protection.
      b. In addition, operators must wear insulating boots and gloves, along with hard hats and safety glasses.

F. Minimum separation between electrical and communications underground cable (measured from conduit sidewall:
   01 Concrete: 0'-3"
   02 Masonry: 0'-4"
   03 Well-tamped earth: 1'-0"

G. Before encasement, the Contractor shall:
   01 Prove and verify all ducts are free of debris and properly installed in support and spacer system.
   02 Verify the system is properly fitted together and hold-down hardware is properly installed.
   03 Verify ducts are capped at both ends

3.3 INSTALLATION

A. Refer to section 27 02 00.

B. Hand Holes

01 Unless otherwise shown, Hand-holes shall be at least 4’-0” X 4’-0” and shall be constructed of 0’-2” thick cement covered with 0’-3/8” steel plate.

02 The hand-hole or maintenance hole shall rest on a 0’-4” blanket of sand, and 0’-4” around the sidewalls shall be filled with sand.

03 Each hand-hole or maintenance hole which contains a pedestal shall have four bollards installed 1’-6” (18”) diagonally from each corner, with a cross member welded at 2’-6” (30”) connecting the four corners.

a. These barriers will be constructed of 0’-4” ridged conduit filled with concrete, driven 4’-0” in the ground and extending 3’-0” above the protective cover.

04 All Hand-holes shall have a hasp and locking plate installed so they can be locked with padlock.

C. Maintenance (Man) Holes

01 Precast concrete maintenance hole components shall be in accordance with ASTM C478/C478M.

02 Maintenance hole components shall be designed for H-20 highway wheel loading and specific site conditions.

03 Maintenance hole bases may be either precast or cast-in-place, as appropriate for the application, with a formed recess shaped to match the first precast shaft section.

a. The maintenance hole base shall extend 0’-10” below the bottom of the lowest pipe and 0’-6” above the top of the largest pipe.

04 Maintenance hole shafts shall be fabricated only from precast shaft sections, eccentric cone sections and grade rings.

05 Precast maintenance holes shall utilize either an integrally cast embedded pipe connector, or a boot-type connector installed in a circular block out opening in accordance with ASTM C923/C923M.

a. Connections to existing maintenance holes shall utilize a boot-type connector per ASTM C923/C923M installed in a cored opening.

b. Cast-in-place bases shall incorporate a ring-type seal on the pipe to be imbedded in the concrete.

D. Concrete and Reinforcing Steel for Encasement

01 Furnish products following Division 03, except strengths as follows:

a. Compressive Strength: 2,500 psi at 28 days, class A

b. Flexural Strength: 500 psi at 28 days

c. Dye concrete encasement “orange” to identify communications conduit

E. The Contractor shall install conduit in excavations following drawings.

01 If directional boring is utilized, cable or flexible conduits can be attached to the unit and pulled back to the origination point (after the drilling unit reaches its destination).

F. The Contractor shall install watertight penetrations through foundation, hand-hole and maintenance-hole walls.

01 Wherever a hand-hole is used to simply pass through, the conduit entrances and exits will be situated at opposite ends of the hand-hole instead of 90° angles.

G. The Contractor shall assemble duct banks with non-magnetic saddles, spacers and separators.

01 Position separators for 0’-2” minimum concrete separation between outer surfaces of adjacent ducts, and:

a. Make uniform required bends with a minimum 2’-0” radius for conduits less than 0’-3” diameter, and a minimum 4’-0” radius for conduits 0’-3” and larger.

b. Maintain vertical or horizontal separations of 1’-0” of well-packed topsoil from any electrical service conduit run parallel to communications conduits.

H. Install concrete encasement fully surrounding reinforcing steel and ducts

I. Unless otherwise noted on the drawings, reinforce with longitudinal #5 steel bars placed at each corner and along each face at maximum parallel spacing of 1’-0” on center, and #5 tie-bars transversely placed at 1’-0” on center maximum longitudinal.
01 Maintain maximum clearance of 0’-2” from bars to edge of forms and ducts.

J. For duct banks that are being installed for future use, extend rebar well past end of concrete for future tie-in to future concrete pour to ensure that both sections are firmly tied together to prevent slippage between the two pours.

K. Add orange colorants at mixing site at the rate of 10 lbs per cubic yard for voice and data cable.

L. Place concrete with minimum 0’-2” cover surrounding ducts and reinforcement.

M. Maintain ducts in proper place during concrete placement.

N. For duct banks that are being installed for future use, all conduits shall be extended minimum of 1’-0” past the end of the concrete and capped.

O. Transition from nonmetallic to metallic conduit where duct banks enter structures or turn upward for continuation above grade
01 Where ducts enter structures such as hand-holes, maintenance holes, pull boxes, or buildings, terminate ducts in proper end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits.
02 Ducts shall be sealed to prevent water and debris from entering the building.

P. Extend below grade conduits to 0’-4” above the finished floor inside a building.
01 Cover or temporarily seal open conduit ends to prevent water and other foreign matter from entering conduit.

Q. Tag conduits entering pull boxes with stamped stainless steel tags following cable and conduit schedule.

R. Backfill after concrete cures 24 hours.

S. The Contractor shall pull a 1’-0” long mandrel (0’-¼” smaller than duct diameter) through ducts.
01 Pull a rag swab or sponge through to remove debris, until it shows clean.

T. Where fiber optic cables will be used and/or where indicated in the drawings, innerduct shall be provided.

U. The Contractor shall provide a metered pull tape in all underground conduits and innerduct:
01 Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
02 Minimum average tensile strength shall be 1,130 lbs for 0’-1.5” and smaller conduits and innerduct.
03 Minimum average tensile strength shall be 1,800 lbs for conduits larger than 0’-1.5”.

3.4 CLEANING

A. Refer to section 27 02 00.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes basic communications and equipment room design requirements and fittings including:
   01 Equipment cabinets, racks, frames and enclosures
   02 Cable management and ladder racks
   03 Telecommunications service entrance pathways
   04 Rack mounted power protection and power strips

B. Related Sections
   01 Section 27 02 00 - Basic Materials and Methods for Communications Systems
   02 Section 27 05 26 - Grounding and Bonding for Communications Systems
   03 Section 27 05 28 - Pathways for Communications Systems
   04 Section 27 15 00 - Communications Horizontal Cabling
   05 Section 27 13 00 - Communications Backbone Cabling
   06 Section 27 05 43 - Underground Ducts and Raceways for Communications Systems

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   01 Refer to section 27 02 00.

D. Codes and Standards (Most recent editions or as required in contract)
   01 Refer to section 27 02 00.

1.3 COMMUNICATIONS ROOMS

A. Communications rooms must be dedicated to designated equipment and services:
   01 Space shall not be used for storage of equipment not related to designated equipment and services.
   02 Hazardous or corrosive materials shall not be stored in the space.
   03 Piping, ductwork and distribution of power, not related to designated equipment and services shall not pass through or be located within the space.
      a. Foreign piping such as water pipes, steam pipes, soil pipes, sanitary drains, storm drains, A/C ducts, and other unrelated systems utilized for or containing liquids, or gases shall not be installed or pass through communication rooms.
      b. With the exception of fire sprinklers, all water pipes shall be routed around communications room.

B. Each communication room shall be equipped with fire detection, fire-extinguishing system and prevention devices. Connect detection devices to base building fire alarm system. A minimum of one (1) smoke detector shall be installed in each communications room.

C. Walls shall be covered with 0'-3/4" X 4'-0" X 8'-0" AC-grade plywood backboard 1'-0" AFF (smooth side to interior of room mounted vertically), capable of supporting mounted hardware and equipment.
   01 Plywood shall be affixed to the studs in the walls with screws that penetrate the studs a minimum of 0'-1", are spaced not greater than 1'-6" (18") apart in each stud, and with screws 0'-0" from the top and bottom of plywood.
   02 Plywood shall be sealed against the wall and painted on all exposed sides with two coats of flat white non-reflective paint.
   03 If applicable fire-treatment verification stamps on plywood shall be left unpainted to be readable.

D. Communications room walls shall extend from floor slab to ceiling deck, with no drop ceilings installed.

E. Cable tray or ladder rack should be used to distribute cables between rooms through finished wall penetrations.

F. Cable ladder rack should be used to distribute cables within rooms, complete with cable bend limiters (drop outs).

G. To reduce static, floors should not have carpet, but be sealed concrete to prevent concrete dust from forming.

H. Communications rooms shall have only one lockable entrance door, a minimum of 3'-0" wide and 7'-0" high, that opens towards the outside of the room, and does not open into another room.
   01 Doors shall be provided with a lockset for the appropriate technology key with pinned hinges and anti-pry guards.
   02 Doors should have no windows or door seals.
   03 Communications rooms should have no exterior identifying markings.

I. Mechanical
   01 Install monitoring sensors with dedicated environmental controls operating 24 hours a day, 365 days a year in the communications rooms.
   02 Provide ventilation in the communications rooms to dissipate heat generated by active devices.
   03 Temperature and Humidity requirements:
      a. Maintain communication rooms at an average of 60°F to 70°F, with a relative non-condensing humidity of 30% to 50%.
      b. The temperature range should be maintained within ± 9°

J. Plumbing
   01 If "wet" fire suppression is used, install wire cages on sprinkler heads to prevent accidental operation.
   02 Do not place sprinkler heads over equipment or cabling. In the event of a leak this will protect the equipment and cabling.
   03 Drainage troughs are also recommended for leakage protection.

K. Electrical
   01 One manufacturer's product is recommended for each type of installation. The mixing of different manufacturer products for one item is not acceptable.

02 No electrical feeders/branch circuits shall be placed in or run through any communications room except as required to service those rooms.

03 The Contractor shall install a slot (a UL-approved fire-rated assembly) to accommodate cable runway entry from corridor and a fire-retardant system (bricks, boards, mechanical, etc). The formed slot shall have no burrs or sharp edges. This opening in the wall will be used to pass data and voice cabling from the corridor cable tray into the communications room.

04 The Contractor shall provide uniform illumination of at least 50 foot-candles (fc) 3'-0" AFF for communications rooms located a minimum of 8'-6" AFF.

a. Light fixtures in communications rooms are to be positioned for maximum lighting. Do not install over cable tray, ladder rack, or 1'-7" (19") standing racks.

b. Provide enough power receptacles to support equipment and service. Coordinate power requirements of active equipment with electrical designer.

L. Relay Racks

01 1'-7" (19") X 7'-0" relay racks are to be used for mounting and termination of inter-building and intra-building fiber optic/ copper cables and components.

a. The racks shall have adequate horizontal and vertical cable management for the 8P8C patch panels and switches.

b. Racks with active electronics shall have rack mounted power strips.

1.4 SUBMITTALS

A. Refer to section 27 02 00.

1.5 QUALITY ASSURANCE

A. Refer to section 27 02 00.

B. Product Standards

01 Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.

02 Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to section 27 02 00.

B. Coordinate layout and installation of equipment with owner's communications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1.7 PROJECT/SITE CONDITIONS

A. Refer to section 27 02 00.

1.8 WARRANTY

A. Refer to section 27 02 00.

B. At the start of the project, contractor shall register the project with the manufacturer to help insure and facilitate manufacturer's warranty process.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 1'-7" (19") x 7" Floor-Mounted 2-post Equipment Racks (OFCI)
   01 Chatsworth (CPI #55053-703)
   02 Owner approved alternate

B. Horizontal Runway and Support Components -ladder tray in MDF/IDF (CFCI)
   01 CommScope760085647 | CR-SLR-10L12W
   02 Owner approved alternate

C. Horizontal Runway Radius Drop (CFCI)
   01 Chatsworth 12" Radius Drop (CPI #12100-712)
   02 Owner approved alternate

D. Cable Runway Elevation Kit A(CFCI)
   01 Black Rack Elevation Kit (CPI #10506-706)
   02 Owner approved alternate

E. Horizontal Rack-Mount Cable Management (CFCI)
   01 CommScope, Front and Rear, 2RU 760128850 | HTK-19-DS-2Uwith covers on front and back
   02 Owner approved alternate

F. Vertical Rack-Mount Cable Management(OFCI)
   01 CommScope, Front and Rear, # 76024478- VCM-DS-84-10B with covers on front and back
   02 Owner approved alternate

G. Labeling
   01 Refer to section 27 02 00.

H. Firestopping
   01 Refer to section 27 02 00.

2.2 ACCESSORIES

A. Rack-mounted Uninterruptible Power Supply (OFOI)
   01 APC SMT3000RM2UC . (2) In MDF, (1) each IDF room.

B. Rack-mounted Power Strips (OFOI)
   01 Chatsworth P-11D0A5 120V 20A One Per Rack

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 27 02 00.

3.2 PREPARATION

A. Refer to section 27 02 00.

B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

C. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 INSTALLATION

A. Refer to section 27 02 00.

3.4 FIELD QUALITY CONTROL

A. Refer to section 27 02 00.

3.5 CLEANING

A. Refer to section 27 02 00.

3.6 ACCEPTANCE

A. Refer to section 27 02 00.

END OF SECTION

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section of the horizontal cabling portion of a structured cabling system includes:
   01 UTP Copper cabling
   02 Termination and patch cables
   03 PoE Injectors and PoE Surge Protectors

B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in communications rooms.

C. Related Sections
   01 Section 27 02 00 - Basic Materials and Methods for Communications Systems
   02 Section 27 05 26 - Grounding and Bonding for Communications Systems
   03 Section 27 05 28 - Pathways for Communications Systems
   04 Section 27 11 00 - Communications Room Fittings

1.2 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   01 Refer to section 27 02 00.

D. Codes and Standards
   01 Refer to section 27 02 00.

1.3 SUBMITTALS

A. Refer to sections 27 02 00 and 27 13 00.

1.4 QUALITY ASSURANCE

A. Refer to section 27 02 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to sections 27 02 00 and 27 13 00.

B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.6 PROJECT/SITE CONDITIONS

A. Refer to section 27 02 00.

1.7 WARRANTY

A. Refer to section 27 02 00.

1.8 MAINTENANCE AND SUPPORT

A. Refer to section 27 13 00

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Labeling
   01 Refer to section 27 02 00.

B. Firestopping
   01 Refer to section 27 02 00.

2.2 ACCEPTABLE COPPER MANUFACTURERS

A. UTP Plenum Rated Cable Cat6 and Cat6A
   01 Commscope
      a. Cat 6 Blue (Data/Voice) - Commscope Part # CS37P BLU
      b. Cat 6 Green (IP Cameras) - Commscope Part# CS37P GRN
      c. Cat 6 Violet (Access Control) - Commscope Part # CS37P VLT
      d. Cat 6A Yellow (Access Points) - Commscope Part# CS44P-YEL
   02 Owner approved alternates

B. Indoor/Outdoor Category 6 and Cat 6A U/UTP, Plenum, Outdoor Rated (OSP). Only for locations run underslab , to exterior , or to other wet enviroments.
   01 Commscope Cat 6 Indoor/Outdoor Part # CS34P-IO
   02 Commscope Cat 6A Indoor/Outdoor Part # CS44P-IO
   03 Or owner approved equivalents

C. Cat 6 and Cat6A Outlet Components Cat6
   01 Commscope
      a. Data - Commscope SL Series Part# 760237628 USL 600 - Blue. Blue in Color for all data drops in the project.
      b. Voice - Commscope SL Series Part# 760237629 USL 600-A.WHT. White in color for all voice drops in the entire project.
      c. IP Cameras - Commscope SL Series Part# 760237630 USL 600-GRN - Green in color for all IP camera drops in the entire project.
      d. Access Control System - Commscope SL Series Part# 760237637 USL 600-VIO. Violet in color for all drops to Access control system.
      e. Access Points - Commscope SL Series Part# 760241143 USL10G- YEL. Yellow in color for all Access Point drops in the entire project.
   02 Owner approved alternates

D. Patch Panels (24 or 48 port) Cat6 and Cat 6A
   01 Commscope Category 6 24-Port Part # 760180042- UNP-6-DM-1U-24
   02 Commscope Category 6 48-Port Part # 760180059- UNP-6-DM-2U-48

03 Commscope Category 6A 24-Port Part # 760162800 | UNP-6A-DM-1U-24
04 Commscope Category 6A 48-Port Part # 760162818 | UNP-6A-DM-2U-48
05 Contactor shall provide cable support bars at back of all patch panels to provide additional support.
06 Owner approved alternate

E. Copper Patch Cords Cat6 and Cat 6A - Pre-assembled
01 Commscope
02 Owner approved alternate

F. Faceplate for wall-mount telephones
01 Semtron Part #1FM-0E-AMP-PHONE
02 Owner approved alternate

2.3 ACCESSORIES

A. Security Camera and Exterior Access Point POE Injectors
01 Contractor shall provide Procet Gigabit PoE injector Model No. PT-PSE109GBRO-AH for Exterior Multi Sensor cameras (TYPE 6).
02 Contractor shall provide Microsemi POE Injector Model No. PD-9501GR/AC-US for exterior access point locations shown.
03 PoE injectors are to be installed in MDF/IDF serving the device. Contractor shall install PoE injector in rack mounted shelf. Label each device with device ID.

B. PoE Device Surge Protector
01 Provide Ditek DTK-MRJPOE Power over Ethernet Surge Protector for all exterior cameras and access points.
02 Surge protector modules are to be grounded to building steel where possible. If grounding to building steel is not possible contractor must homerun ground to telecom grounding system.

C. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner.

D. Provide clear plastic lamination serving each communication room.

E. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

2.4 HORIZONTAL COPPER CABLING

A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:
01 Category 6 UTP cable
02 Catergory 6A UTP Cable

B. Category 6 UTP Cable Requirements
01 23/24 AWG solid bare copper.
02 Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum).

03 Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

04 Cables shall be marked as UL verified with a minimum of Category 6 rating.

05 The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 Mhz) of analog broadband video.

06 The maximum horizontal cable tested length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295'-0". It's contractor's responsibility to reroute as necessary to bring all cable runs within distance limit without additional cost to the project. Plan ahead and get approval or exception from Owner before pulling the cables that would ne over the distance limit.

07 Cable shall meet or exceed the following electrical characteristics:

08 Cable shall be specified to 250 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications.

2.5 TERMINATION HARDWARE

A. Patch panels

01 Patch panels shall be rated to match installed cable plant

02 The wiring block shall accommodate #23 AWG cable conductors.

03 All modular cross connect panels shall be UL-listed.

B. Work Area Outlet Cat6 and Cat 6A

01 Universal eight-position jack pin/pair assignments

02 Jack Color:

a. Data: Blue

b. Voice:White

c. IP Cameras : Green

d. Access Control : Violet

e. Access Points: Yellow

f. or approved alternates

C. Work Area Outlet Faceplates:

01 4-Port Single Gang Stainless Steel Semtron Part # 1FM-(4)0E-AMP-LAB

02 Or owner approved alternate

2.6 PATCH CABLES

A. Workstation Patch Cables:

01 Contractor shall provide (1) 10' Category 6 Patch cable for each data drop in the entire project and (1) 10' Category 6A patch cable for each Access Point drop, in the entire project.Contractor shall provide (1) Category 6 Outdoor rated (OSP) Patch cable of required length to each exterior IP camera in the project. Patch cables are to be color coded.All patch cables are to be pre-assembled by the manufactue

a. Data Drops: Commscope Uniprise Part # UC1BBB2-0ZF010- Blue in Color

b. Voice Drops: Commscope Uniprise Part # UC1BBB2-08F010- White in Color

c. IP Camera Drops: Commscope Uniprise Part # UC1BBB2-0MF010 -Green in Color

d. Access Control System: Commscope Uniprise Part # UC1BBB2-0LF010 - Violet in Color
e. Access Points -Commscope Uniprise Part # UC1AAA2-09F010- Yellow in Color
f. Exterior IP Cameras - Commscope Part # CO15542 - CO15542-01F0** - OSP Black in Color .(**) Shall be replaced with numeric value representing the required length. Contractor shall field verify required length.

B. Network Rack Patch Cables (MDF/IDF):
01 Contractor shall provide (1) 6' Category 6 patch cable for each data drop in the project. Provide (1) 6' Category 6A for each Access Point drop in the entire project. All patch cables are to be pre-assembled by the manufactuer. Provide patch cords to owner representative. TBISD is to patch into Network Equipment.
a. Data Drops: Commscope Uniprise Part # UC1BBB2-0ZF016- Blue in Color
b. Voice Drops: Commscope Uniprise Part # UC1BBB2-08F006- White in Color
c. IP Camera Drops: Commscope Uniprise Part # UC1BBB2-0MF006- Green in Color
d. Access Control System Drops: Commscope Uniprise Part # UC1BBB2-0LF006- Violet in Color
e. Access Point Drops - Commscope Uniprise Part # UC1AAA2 -09F006- Yellow in Color
02 Contractor shall verify exact quantities and lengths with Owner prior to purchase
03 Coordinate with Owner on the active equipment layout prior to purchase to ensure correct sizing of patch cords from patch panels to switching equipment.
04 Place each size/length patch cord in a separate container, and mark the containers that hold the patch cords with the length of patch cords contained within.
05 All cords shall conform to the requirements of ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program.
06 Cords shall be equipped with an eight-pin modular connector on each end, wired straight through and shall be of appropriate length for application.
07 All rated patch cords shall be round, and consist of #23 AWG copper, stranded conductors, tightly twisted into individual pairs.
08 Patch cords shall be made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.

2.7 IDENTIFICATION (LABELING) SYSTEM

A. Refer to sections 27 02 00 and 27 13 00.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 PREPARATION

A. Refer to section 27 02 00.

B. The Contractor shall check pathways, raceways, and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation prior to installation.

3.3 INSTALLATION REQUIREMENTS

A. Refer to section 27 02 00.

B. All installation shall be done in conformance with ANSI/TIA-568-C standards, BICSI methods, industry standards and manufacturer`s installation guidelines.
   01 The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.
   02 Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.
   03 This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

C. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.
   01 Pull cables in smooth and regular motions using methods that prevent cable kinking.
   02 Pull cables simultaneously if more than one is being installed in the same raceway/pathway.
   03 If necessary, use approved cable pulling lubricant
   04 Use fish tape, cable, rope, basket weave wire/cable grips, and other tools that will ensure no damage to the media or raceway.
   05 Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.
   06 Do not bend cable greater than a bend radius of 0’-1”.

D. Provide a 10’-0” service loop at the communications room and shall provide a 3’-0” service loop above the access ceiling or cable trays unless specified otherwise.
   01 All service loops shall be a minimum of 1’-6” (18”) in diameter and be accessible for maintenance.
   02 Provide all camera and access pont field location with minimum 10' service loop.

E. Coordinate loop placement and orientation with the technology consultant.
   01 This allows for future changes or expansion without installing new cables.

F. Install cables in continuous “home run” lengths from work station outlet to specified patch panel.
   01 No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the workstation outlet without written Owner permission.

G. All cable must be handled with care during installation so as not to change performance specifications.
   01 Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable.
   02 There shall never be more than 0’-1/2” of unsheathed cable at either the wiring closet or the workstation termination locations.

H. All cabling and associated hardware shall be placed so as to make efficient use of available space.
   01 All cabling and associated hardware shall be placed so as not to impair equipment`s efficient use of their full capacity.

3.4 CABLING METHODS

A. The Contractor shall provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system.
   01 Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used.
   02 Use UL or ETL listed plenum rated cable in all spaces.
   03 Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.

B. Conceal raceway and cabling except in unfinished spaces as is practical.

C. Exposed Cable
   01 All station cabling shall be installed inside walls or ceiling spaces whenever possible.
   02 Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist.
      a. Owner must approve all exceptions.

D. The Contractor shall utilize conduits/cable tray as indicated on the drawings.

E. All cabling placed above drop ceilings must be supported by cable tray, J-hooks, caddy bags or conduit.
   01 The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported.
      a. Attaching cable to pipes or other mechanical items is not permitted.
      b. Cabling shall not be attached to ceiling grid wires.
   02 Multiple cables are to be dressed every 5’-0” to 7’-0”.
      a. Maximum cable sag between cable hooks is 3”-6”.

F. The Contractor shall route data and voice cables separately in a neat and orderly fashion.

   01 No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Cable ties shall be rated for the environment.

G. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes.

H. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks’ contacts.
   01 Envelope will be removed on final trim out after other trades have completed their finish work.
   02 It shall be the Contractor’s responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.
      a. Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are on the floor.
      b. Cable pulling force shall not exceed 25 lbs of pulling tension or cable manufacturer’s recommended pulling tensions.
      c. Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.

I. Communications room cables shall be combed and dressed in a manner as to prevent twists, “braiding” and crossed cables in the cable bundle from the communication room entrance to the termination point at the rear of the patch panel.
   01 Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.
      a. Use Velcro wraps instead of cables ties for all bundling in the communications rooms.
      b. Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the communications room.

3.5 CABLING SEPARATION

A. Comply with TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

B. Maintain a minimum spacing of 1’-6” (18”) from electrical feeders and/or branch circuit wiring including, but not limited to, light fixtures, sources of heat and EMI sources.

C. Maintain a minimum spacing of 1’-0” from auxiliary systems cabling.

D. Maintain a 1’-0” separation where cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems.
   01 Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.

E. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10’-0” is recommended.

3.6 CABLING TERMINATION

A. Terminate cables in consistent consecutive order.

B. Terminate cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.

C. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.

D. Provide a 10’-0” service loop for horizontal cables at each rack in communications rooms.
   01 Locate loop at ceiling deck or on bottom of cable runway in minimum 1’-6” (18”) diameter.

E. Provide a 3’ service loop for horizontal cables at work area outlets. Locate service loop above or below data/voice outlet were vertical cable run transitions to horizontal run.

F. Maintain twists in cable pairs to within 0’-1/2” of termination.

G. Building Systems Cabling (BAS, FA, elevator line, etc)
   01 Coordinate exact placement and connectivity requirements with applicable trade prior to installation.
   02 Group all building systems cables in one group.
   03 Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.

H. Limit cable-bending radius to 20X the cable diameter during installation, and 15X the cable diameter after installation.

I. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.
   01 The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

3.7 TERMINATION HARDWARE

A. Station Hardware
   01 Flush mount jacks shall be mounted in a faceplate with back box.
   02 Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.
   03 8P8C Jack Pin Assignments for work area outlets shall match the T-568B wiring scheme.

B. Patch panels
   01 Copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels.
   02 All Modular jack panels shall match the T-568B wiring scheme.

C. Work Area Outlet
   01 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA-568-C compliant for the specified transmission requirements

D. Work Area Outlet Faceplates:
   01 Furnish and install blank plates in all unused ports.

3.8 SPECIAL CIRCUITS

A. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits, including cables to wireless access point locations, security, elevators, fire alarms, etc.

B. Wireless Access Points
   01 Install two (2) cable(s) from dedicated wireless patch panel(s) in communications room to outlets having 8P8C connectors within a BISCUIT box.
   02 Enclosures shall be NEMA rated for the environment to which they are exposed.
   03 30’-0” of cable slack shall be coiled and hung on a “J”-hook at the enclosure location.

3.9 IDENTIFICATION AND LABELING

A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.

B. Labelling scheme shall meet Owner’s IT cabling standard and industry standards and best practices. Submit labelling scheme for approval before work to start.

C. Fiber termination hardware (designation strip) shall have a 0’-3/4” x 0’-1/4” thermal transfer printable label with a permanent acrylic adhesive

D. All labels shall be permanent and shall not fade, peel, or deteriorate due to environment or time.

E. The Contractor shall provide a copy of the finalized plan in writing to the Owner representative and DBR for review and authorization to proceed.
   01 Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.

F. Labeling requirements:
   01 Label cable terminations on designation strips
   02 Label all cable at each terminating point.
   03 Label each port of the work area outlet.
   04 Cable identification numbers shall not be duplicated.
   05 Label patch panels in the communications rooms to match those on the corresponding voice and data outlets.
      a. The font shall be at least 0’-1/8” in height.
   06 Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if applicable, the access point identification number. Coordinate labeling of grid with Owner and Architect prior to application of labels.
   07 Label each distribution rack, block and other terminating equipment unit and field within that unit within 0’-4” from the block or patch panel termination. Keep labels in a neat and orderly lineup.
   08 Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms.
      a. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
   09 Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

G. Location and termination field description
   01 Room location
   02 Rack-mount or Wall mount
   03 Termination field type
      a. Specific patch panel ports versus a separate dedicated patch panel

H. Unique identifiers
   01 Segregation and position on equipment rack
   02 Port color-coding
   03 Unique labeling

I. Documentation
   01 Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
      a. All labels shall correspond to as-built drawings and to final test reports.
   02 All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.
   03 Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
   04 Complete cross connect documentation is required.

3.10 FIELD QUALITY CONTROL

A. Refer to section 27 02 00.

3.11 POST-INSTALLATION TESTING

A. Contractor shall test each pair or strand of every cable prior to acceptance. (100% PASS)

B. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.

C. Standards Compliance and Test Requirements:
   01 Cabling shall meet ANSI/TIA-568-C.2 Category 6 Horizontal cabling requirements.

D. Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin.
   01 These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements.
   02 Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.
   03 Length, propagation delay, and delay skew relative to the relevant limit.
      a. Length, propagation delay, and delay skew shall be tested relative to the relevant limit.
      b. Test shall also include mutual capacitance and characteristic impedance.
         1) Any individual test that fails the relevant performance specification shall be marked as a ‘FAIL”.

E. Cable Test Documentation:
   01 Cable test documentation shall be submitted in hard copy and electronic formats.
      a. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results.
      b. Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report.
      c. Certificate shall reference traceable circuit numbers that match the electronic record.
   02 Each test record shall contain the cable ID as follows:
      a. “MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #”, e.g. MM-MC-HC23-001.
   03 Test results saved within the field-test instrument shall be transferred into an accessible database utility that allows for the maintenance, inspection and archiving of the test records.
      a. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”.
      b. The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
   04 Test reports shall include the following information for each cabling element:
      a. Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
      b. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
      c. Cable manufacturer, cable model number/type, and NVP
      d. Tester make & model, serial number, hardware version, and software version.
      e. Cable ID and project name
      f. Auto-test specification used
      g. Overall pass/fail indication

h. Date of test

F. Cable Test Equipment
01 Contractor shall supply all of the required test equipment used to conduct acceptance tests.
02 Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
03 Testing equipment shall be UL-verified to meet Level III accuracy.
a. The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
04 Testing equipment shall be within the calibration period recommended by the manufacturer.
05 Testing equipment shall have the latest software and firmware installed.
06 Testing equipment of a given type shall be from the same manufacturer, and have compatible electronic results output.
07 Test adapter cables shall be approved by the manufacturer of the test equipment.
a. Adapter cables from other sources are not acceptable.
b. Adapter cables must be replaced after 1000 tests to ensure accuracy.
08 Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
09 Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
10 Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
11 Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
12 Test equipment must include a library of cable types, sorted by major manufacturer.
13 Test equipment must be able to internally group auto tests and cables in project folders for good records management.
a. Test equipment must store at least 1000 auto tests in internal memory.
14 Test equipment must include DSP technology for support of advanced measurements.
15 Test equipment must make swept frequency measurements in compliance with TIA standards.
16 The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector.
17 There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.
18 Acceptable testers:
a. Fluke DTX CableAnalyzer
b. Owner approved equivalent

3.12 CLEANING

A. Refer to section 27 02 00.

3.13 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Contractor’s RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "* PASS" (asterisk) will not be acceptable.

01 These circuits must be repaired to meet "PASS".

END OF SECTION

SECTION 27 41 16

INTEGRATED AUDIO-VIDEO SYSTEM AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This document covers the general requirements for the installation of audio-video (AV) systems.

B. Contractor shall provide and install all AV-Cabling in the project.

C. Contractor shall install local sound reinforcement system in new soccer field pressbox.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections
   01 Section 27 02 00 - Basic Materials and Methods for Communications Systems
   02 Section 27 05 28 - Pathways for Communications Systems
   03 Section 27 05 26 - Grounding and Bonding for Communications Systems
   04 Section 27 15 00 - Communications Horizontal Cabling

1.3 CODES

A. 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.

B. The equipment, materials, and installation shall confirm to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
   01 NFPA 70, National Electrical Code.
   02 NFPA 101, Code for Safety to Life from Fire in Buildings and Structures.
   03 FCC Rules, Part 76.
   04 UL 50, Enclosures for Electrical Equipment.
   05 All applicable parts will be FCC Class B approved.
   06 All equipment, cable, devices, and accessories provided shall be listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
   07 Americans with Disabilities Act.
   08 Texas Accessibility Standards.
   09 International Building Codes (IBC).
   10 State and Local Building Codes with Amendments.
   11 All requirements of the local Authority Having Jurisdiction (AHJ).

1.4 REGULATIONS

A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.

1.5 SUBMITTALS

A. General
- 01 Refer to Division 1 and section 27 02 00.
- 02 Submit in quantities, format and timetable as required by General Conditions.

B. Product Data Binders
- 01 Minimum number of Sets: four (4) or one (1) electronic copy on CD.
- 02 Timetable
  - a. Submit within thirty (30) days after award of contract.
  - b. Submit simultaneously with Shop Drawings.
  - c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
  - d. Review and approval of Product Data is required before equipment purchase and installation.
  - e. Bind product data sheets together either in GBC or 3-ring type binders.

C. Shop Drawings
- 01 Minimum Number of Sets: four (4) or one (1) electronic copy on CD.
- 02 Timetable
  - a. Submit within thirty (30) days after award of contract.
  - b. Submit simultaneously with Product Data Binders.
  - c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
- 03 Description:
  - a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
  - b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
  - c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, AV Consultant, Date and Revision Number.
  - d. Number and title each drawing in logical manner as a set.
  - e. Include cover sheet with listing of all drawings included in bound set.
  - f. Ensure that labeling on Shop Drawings match labeling on equipment.
  - g. Minimum Scale:
    - 1) Floor Plans: 1/8 inch = 1 foot.
    - 2) Rack Elevations: 1-½ inch = 1 foot.
    - 3) Plate/Panel Details: 6 inches = 1 foot.
    - 4) Loudspeaker Details: 1 inch = 1 foot.
  - h. Include as a minimum:
    - 1) Floor plans indicating locations of all AV devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
    - 2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
    - 3) Plate details showing size, material, finish, connectors, engraving, etc.

4) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:

a Itemization of items reviewed by the Structural Engineer.

b Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.

c Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.

5) Rack elevations.
6) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
7) Electrical power wiring diagram. Include circuit, switching, and control details.
8) Wiring diagram of grounding and shielding scheme.
9) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
10) General construction drawings necessary for completion of work.

D. Operation and Maintenance Manuals
01 Minimum number of Sets: four (4).
02 Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
03 Format and Minimum Information below:
a. Section 1 - System Operation.
1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
3) Certificate indicating names of Owner personnel trained by AV Contactor, date of training, name of AV Contractor representative that provided training, and name of project.
b. Section 2 - System Documentation.
1) Simplified system one-line schematic diagram showing changes made during construction.
2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
4) All Shop Drawings corrected to reflect as-built conditions.
5) Other data and drawings required during construction.
6) Initial Tests and Adjustments data.
7) Final Tests and Adjustments data.

8) CD-ROM discs including all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).

c. Section 3 - Manufacturer's Documentation.
1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
2) Manufacturer's Product Data.
3) Operating instructions.
4) Installation instructions.
5) Service information.
6) Schematic diagrams.
7) Replacement parts list.

d. Section 4 - Maintenance Information.
1) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
2) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
3) Troubleshooting information complete with instructions for procedures during equipment failure.

e. Section 5 - Warranty Information
1) System warranty letter.

04 Provide three (3) sets on CD-R disc that include all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.

05 Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.

06 Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.

E. Samples.

01 Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.

02 Product Tests
a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
b. Obtain written approval of tested products before incorporating into system.

1.6 QUALITY ASSURANCE

A. AV Contractor Qualifications.

01 Be established AV System Contractor, regularly engaged in furnishing and installing AV systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved AV Contractor as subcontractor to perform work described herein.

02 Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner's request, accompany Owner or Owner's representative on visit to any or all example completed projects submitted.

03 Be Authorized Dealer for all major lines of equipment listed in Part 2 (Biamp, Chief, Crestron, JBL, Middle Atlantic, Shure, etc.) Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.

04 Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.

05 Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating AV systems of similar scale. Project Manager shall also have either an AVIXA CTS-I or CTS-D certification.

PART 2 - PRODUCTS

2.1 GUIDELINES

A. Infrastructure Products - All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.

B. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer's published specifications. Verify performance.

C. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.

D. Quantities - All quantities are indicated on AV drawings or in Part 2 AV Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.

E. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.

F. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

G. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.

H. Security Screws - Use Bryce Security Penta-Plus button-head screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers (not provided by Bryce) to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do no use a bit beyond the manufacturer's recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.

I. AV Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.). Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.

J. AV Screens - For any screen specified, size as indicated in drawings. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48" above finished floor, and include additional black drop as appropriate considering screen size and mounting height.

K. AV Racks:
   01 Provide blank faceplate in any area marked BLANK in drawings.
   02 Provide shelf for mounting of any device for which rack mount kit is not available.
   03 PanelcraftersProvide one (1) Panelcrafters DBR-XXXXX-RHIM-01 designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add AV Contractor graphic to the "integrator" section (approximately 8.5" x 1.75" of the right-hand side). All alternates must include AV Consultant graphic. Submit to AV designer for approval of final plate design prior to purchasing and installation.

L. Control System Programming:
   01 Program each panel to provide simple, intuitive control of all basic AV functions including:
      a. program and speech volume levels
      b. video source and destination routing
      c. screen control
      d. video projector lift control (where applicable)
      e. AV system power
      f. media player transport functions
      g. video conferencing CODEC controls including call initiation (where applicable)
      h. video conferencing PTZ camera control (where applicable)
      i. combine/uncombine settings for all combinations of controlled rooms
      j. local lighting and blackout shade controls (where applicable)
   02 Utilize AVIXA's "Dashboard for Controls" concept and Crestron's SMART GRAPHICS for touch panel layout unless directed otherwise by Owner.
   03 Provide layout of each and every touch panel and hard-button panel pages in the product data submittal for approval by Owner.
   04 Provide web-control for each touch panel in AV system. Include page tracking, and track current button feedback between touch panel and web-control panel.
   05 Staff member certified by control system manufacturer shall program control system.

06 After programming is approved, all control system code and programming, including touch panel code and graphics, will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.
07 Provide follow up meeting with Owner after 6 months of operation to make updates as requested to control programming.

M. Audio System Programming - Owner shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in AV submittal. After AV system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.

N. AV Design Bid & Substitutions:
01 System design is around products listed in Part 2. Intent of product specification is to provide standard of quality and function for installed materials. Certain performance specifications are given to clarify job requirements.
02 Bid AV system with products specified in Base Bid section below unless noted otherwise from Owner.
03 No substitutions will be allowed without prior approval from Owner specific to proposed manufacturer and model numbers.
04 Equipment listed in Part 2 is based on performance criteria to meet Owner design requirements.
05 All requested substitutions need to meet or exceed performance of devices listed in Part 2. For each request provide manufacturer's published specifications to verify performance and explain functional and cost impact.
06 Evaluation and approval of substitution requests will be performed by Owner.

2.2 ROOM DESCRIPTIONS

2.3 AV PRODUCTS - ACTIVE EQUIPMENT

A. The following are major products for this project.
01 Pressbox Speakers
a. Community R.35-3896
b. Or Owner Approved Equivalent
02 Amplifier
a. Crown CDI 1000
b. Or owner Approved equal
03 Digital Signal Processor
a. Biamp TesiraFORTÉ AI
b. Or owner approved equal
04 Table top Microphones
a. Shure MXW8
b. Or owner approved equal

2.4 CABLES

A. Interconnect Wiring – Provide and install following cable as required for connections in all areas. Meet provisions of N.E.C. Provide plenum rated cable where required.

B. AV Cabling
01 Low Impedance Loudspeaker Cable
a. For cable distance <50': 14-guage 2-conductor West Penn #25226B
b. For cable distance from 50' to 100': 12-guage 2-conductor West Penn #25227B

c. For cable distance > 100', consult with manufacturer and engineer before ordering/installation.
d. Terminate with Neutrik "Speakon" type connectors when available.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Guidelines

01 Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.

02 Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge AV infrastructure system installations.

03 [if !vml][endif]Provide a complete functioning sound system that's been fully tested and properly balanced, configured, and equalized. Be of maximum assistance to the Owner during the warranty period of the system, to the degree that maximum Owner satisfaction is assured.

04 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

05 Provide all audio circuits balanced and floating, except as noted in the Specifications 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 outputs of the various equipment items in the system

06 Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (video, microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.[if !vml][endif]

07 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.

08 All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.

09 All solder joints and terminations shall be made with resin-core silver 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.

10 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 type crimping tools are unacceptable, and shall not be used on the job site.

11 Label all wires in racks and console as to destination and purpose with permanent labels. Clearly and permanently label all controls and connections at the front and back of the rack, with permanent labels. Wall plates and custom panels shall be engraved and filled with contrasting paint, unless otherwise noted. All labeling shall be completed prior to final system inspection.

12 Documents at Job Site - Keep following documents at job site during entire construction period:
   a. Complete Specifications and Drawings.
   b. Approved Shop Drawings.
   c. Approved Product Data.
   d. Progress Set of Project Record Documents.

13 Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.

14 Locate wireless microphone system and hearing assist system antennas at or above ceiling or at bar joist height in areas without ceilings. Coordinate exact location with Owner to provide adequate coverage in the area served by the system. Adjust antenna location for best possible reception/transmission in area of coverage.

15 Provide adequate protective vandal guards for all devices located in areas subject to damage from activities or vandalization, such as school gym, sports field, school cafeteria.

16 Provide hearing assist transmitter(s) and receivers for each sound reinforcement system. The quantity of hearing assist receivers for each system shall be equal to a minimum of four (4) percent of the total seating capacity, but in no case less than ten (10) receivers for the area of coverage of each local sound reinforcement system.

17 Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.

18 Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.

19 Coordinate installation of AV infrastructure and equipment with other trades in order to follow project schedule.

20 Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

B. Labeling

01 Equipment Labels - AV Contractor shall provide engraved lamicoid labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:
   a. Line 1: Generic name of device, such as MIXER AMPLIFIER.
   b. Line 2: Schematic designation of device, such as AV-MSW-1.

02 Control Labels - AV Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.

03 Terminal Strip Labels - AV Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.

04 Rear Equipment Labels - AV Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.

05 Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.

06 Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.

C. Power and Grounding

01 Power Coordination - Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to AV systems. Before installation, verify load requirements for systems as accepted.

02 Bus Bars - Install 1-inch by 1/4-inch copper ground bus bar, top to bottom in floor mounted AV racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 26) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.

D. Equipment Racks

01 Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use “whisper” type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.

E. Wiring

01 Wiring Standards - Execute wiring in strict adherence to best AV engineering practices.

02 Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or “Skotchlock” connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.

03 Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.

04 Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length 3/4-inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from rack mounted equipment with plastic cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.

05 Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.

06 Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.

07 Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.

08 Racks - Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.

09 Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.2 FIRESTOPPING

A. Refer to section 27 02 00.

3.3 STORAGE AND HANDLING

A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.

B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.

C. Schedule delivery to minimize delays in the project.

D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.4 WARRANTY

A. Refer to Division 1.

B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:

01 System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.

02 Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.

03 Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.

04 Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.

05 Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.

06 Extended Manufacturer's Warranties - Identify products with manufacturer's warranties extending beyond one (1) year. Provide terms and conditions of such warranties.

07 Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.

C. Extended Warranty - Provide cost to extend complete AV system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

3.5 INITIAL TESTS

A. Purpose - These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).

B. Testing Standards - Perform testing in accordance with ANSI standards.

C. Inspection - Verify prior to beginning actual tests and adjustments on systems:

01 Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).

02 Cables dressed, routed, and labeled, connected with proper polarity.

03 Insulation and shrink tubing in place.

04 Dust, debris, solder splatter, etc. removed.

05 Proper frequency settings (or modules) at crossovers and controllers.

06 All equalizer bands and tone controls set for flat frequency response.

07 Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.

D. Electrical Power Quality - While all sound and AV system components are unplugged from electrical power outlets, AV Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). AV Contractor to document measurements.

E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.

F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.

3.6 FINAL TESTS AND ADJUSTMENTS

A. Purpose - These tests are to be witnessed by AV Consultant to determine if system is complete and functioning as designed and specified. Also, AV Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.

B. Timetable - Coordinate with Owner, General Contractor, and AV Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.

C. System and Site Conditions - AV Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant's arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon AV Consultant's arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or AV Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.

D. Test Labor - Provide technician familiar with this project's AV systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.

E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.

F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.

G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, AV Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

H. Installer shall perform thorough preliminary testing of the AV Systems prior to the final inspection by the Consultant. All systems and subsystems shall be tested to ensure that they are in proper working order and meet the performance specifications. Perform preliminary programming and setup of digital signal processors as necessary to conduct these tests.

I. 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 one (1) competent technician who is familiar with the project, and who will be prepared to stay as long as his services are needed. It is estimated that approximately eight (8) hours will be required for this work

J. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.

K. Coordinate as necessary to ensure a totally quiet room during the sound reinforcement systems testing and balancing period.

L. Prior to requesting systems testing, verify the following:
   01 All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published.
   02 All specified equipment, including loose equipment, is on the job site for proper accounting.
   03 All loudspeaker circuits have been tested, are connected to the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit in PDF format prior to final tests.
   04 All video systems and associated control systems have been tested and are in perfect working order.
   05 All equipment controls shall be labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control on the front and in the rear of the racks as to its function with write-on tape. Supply printer labels or markers suitable for permanently indicating knob settings after equalization is performed.
   06 Operation manuals for every equipment item furnished are on hand at the job site.
   07 Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing. Installer shall provide a calibrated RTA and microphone, and pink noise generator at time of testing.

M. 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.

N. The 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.

3.7 SOUND SYSTEM PERFORMANCE

A. After equalization and testing, the sound system shall meet or exceed the following specifications:
   01 System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.
   02 Minimum SPL with band-limited pink noise input to the system in the targeted space shall be 95 dB before audible distortion occurs.
   03 Seat-to-seat variation in SPL at 4kHz octave band pink noise shall be within a tolerance of plus or minus 3dB SPL.
   04 Acoustic response of the system shall be plus or minus 1.5dB along a line which is flat from 50 Hz to 4000 Hz and which rolls off at 1dB per octave to 16kHz.

B. The following tests and adjustments shall be performed by the Contractor. All equipment required supplied by the Contractor Follow EIA standard RS-160 and RS-219 in performing the tests. Make 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 and Engineer prior to scheduled equalization and final inspection date.
   01 Measure and record impedance of each speaker line at frequency of 1,000 Hz, with loudspeakers connected to their respective lines.

02 Measure and record overall system hum and noise level of each input channel with controls set so that -50 dBm microphone input or +4 dBm input would drive the system to full amplifier output. Terminate inputs with resistor (150 to 600 ohms) and disconnect power to noise generator for this test.

03 Adjust the gain of each active device to provide both optimum signal - to noise ratio, and at least 10 dB headroom at each active device. Observe the output of each active device with an oscilloscope of 5 MHZ band width, and verify visually that the signal required for full amplifier output is free of overload, clipping, parasitics, and radio frequency components. Adjust gain structure of all active components and record the input and output signal levels of all active components and record the input and output signal levels of all active components in both dBm and volts, during normal program levels.

04 Measure and record system electrical frequency response for each input channel through power amplifier. Required is flat response with permissible deviation of +/- 1 dB within the range of 30 Hz to 16 kHz.

05 Check system to assure 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 on Oscilloscope at termination.

06 Check phasing of loudspeakers by applying constant power per octave (pink) noise to system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next. Apply sine wave sweet signal to each loudspeaker system sweeping from 50 Hz to 5,000 Hz and at a level of 10 Db below full amplifier output, and listen for rattle or objectionable noises Correct if apparent.

07 Achieve uniform distribution of sound from each loudspeaker (with bleachers in their extended position in gymnasium where applicable). Drive system with broadband, constant power per octave (pink) noise, and measure the SPL using a sound level meter incorporating an octave-band filter centered at 4 kHz. Adjust noise level until the meter readings are between 75 and 80 dB. Use a sound level meter filter that meets ANSI S1 4-1971 Type 2 and ANSI S1 11-1971 standards set for slow meter damping. Take all readings at seated ear height. Adjust speaker as necessary to achieve +/-3 dB over entire area covered by this system.

3.8 FINAL ACCEPTANCE BY OWNER

A. Certificate - Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.

B. General Adjustments - Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.

C. Input/Output Jack Demonstration - Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at AV and network systems.

D. Inventory - Inventory all installed and portable equipment for correct quantities.

E. Functional Demonstration - Demonstrate operation of each function of each major piece of equipment.

F. Other Tests - Perform any other tests on any part of the AV system as requested by Owner.

G. Final Equipment Settings - Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.

H. Security Inspection - Inspect equipment for security from tampering (covers, shaft-locks, etc.).

I. Review of Labels - Review installed labels on cables, equipment, controls, and terminal strips.

3.9 OWNER TRAINING

A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding AV Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

3.10 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of each completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. hould Owner exercise this option, contractor presence will not be required at first use following final completion.

END OF SECTION

SECTION 27 51 29

EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions, Division 1, Division 20, and Drawings apply to all Work herein.

B. Requirements of the following Division 20-28 Sections apply to this section:
   01 Scope of Work - Section 27 02 00
   02 Fire Alarm System - Section 28 46 00

1.2 SCOPE

A. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local fire department and other agencies and authorities having jurisdiction. System users shall receive and transmit radio broadcasts from their portable radio units within the building. This shall be accomplished utilizing the following components:
   01 Bi Directional Amplifiers (Signal Boosters)
   02 Plenum rated Coaxial Cable
   03 Antennas
   04 Cable taps
   05 Connectors
   06 Power dividers
   07 Other components and interconnecting circuitry as required

B. The system shall comply with the requirements of UL 2524 In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72, NFPA 1221 and ICC (IFC), as referenced.

C. The entire system shall meet with approval of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).

D. The work in this section shall include the responsibility for all filings with the AHJ. Where filings require engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.

E. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner

F. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included as the part of the required work.

G. The in-building emergency radio communication enhancement system shall use a UL 2524, NFPA 72, NFPA 1221 and ICC (IFC) compliant NOTIFIER® signal booster or approved equal.

H. All conductors shall be installed in conduit. Conduit installation shall be as specified in the Conduit Section.

I. Related Sections: Other Division 20-28 Sections contain requirements related to the work of this Section. These may include, but not be limited to, the following sections:
   01 Conductors - Section 26 05 19
   02 Conduit - Section 26 05 33 and 26 06 34
   03 Outlet Boxes - 26 05 33

1.3 QUALITY ASSURANCE

A. Basis: To establish the type, quality and features of the system required, the equipment specified is that of the Notifier Fire Systems. All references to manufacturer or supplier model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required. All equipment proposed as an EQUAL to that specified shall COMPLETELY conform to the Specifications herein.

B. Manufacturers: If they comply with these specifications and requirements, products of the following manufacturers will be acceptable:
   01 Notifier Fire Systems (Provided by Fire Tron)
   02 Or Engineer approved equal.

C. Contractor Qualifications:
   01 The equipment supplier shall be an authorized and designated representative of the In-building Radio System Manufacturer to sell, install, and service the proposed manufacturer`s equipment. The equipment supplier shall have technical factory training specifically for the system proposed.

D. Codes and Standards: The system shall comply with the applicable Codes and Standards as follows:
   01 National Fire Protection Association Standards:
      a. NFPA 70 National Electrical Code
      b. NFPA 72 National Fire Alarm Code
      c. NFPA 101 Life Safety Code
      d. NFPA 1221 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
   02 The Americans with Disabilities Act (ADA).
   03 The Texas Accessibility Standards.
   04 Local and State Building Codes.
   05 Requirements of Local Authorities having Jurisdiction.

1.4 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:
   01 Riser wiring diagram with associated conduit sizes.
   02 Complete floor plan drawings locating all devices and interfaces associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type.
   03 Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage and configuration.
   04 Detailed written system description in this Specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
   05 Complete Bill of Material for reference.

B. All submittal data shall be in bound form with contractor`s name, supplier`s name, project name, and state fire alarm license number adequately identified.

C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been 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.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.

B. Critical Areas such as Fire Command Center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.

C. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.

D. The In-building emergency radio communication enhancement systems must provide the following signal strengths:
   01 Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
   02 Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.

E. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.

F. EC shall sub-contract an approved manufacturer or a qualified and approved vendor to supply, test and determine locations of components which are required for proper operation as well as to supply, deploy, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.

G. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.

H. The system design shall be based on the NOTIFIER® line of Public Safety Signal Boosters UL 2524, NFPA 72, NFPA 1221, ICC (IFC) and FCC compliant to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waiver any requirement or performance of individual components described in the specifications.

I. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.

J. Survivability from attack by fire shall meet NFPA 72, National Fire Alarm and Signaling Code, and NFPA 1221.

K. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.

L. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20 dB under all operating conditions

2.2 PERFORMANCE REQUIREMENTS

A. The basis of design system is specified based upon NOTIFIER® line of Public Safety UL 2524, NFPA 72, NFPA 1221, ICC (IFC) compliant signal boosters.

B. The signal booster shall be a Class B Public Safety type as designated by the FCC and as required by the AHJ.

C. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72 and NFPA 1221. The signal booster shall have both the primary and the secondary power supplies built in a fully sealed NEMA-4 type approved enclosure.

D. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

E. The signal booster shall be set and tuned by the equipment manufacturer to pass frequencies as specified by the local fire department.

F. To reduce the possibility of unwanted interference affecting the operation of the system, signal boosters shall be band or channel selective type with a maximum 3dB channel bandwidth of 200KHz (Fc +/- 100KHz). Wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.

G. Signal Boosters shall have oscillation prevention circuitry to protect the public safety radio system in case of signal booster malfunction.

H. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 25dB range. System gain shall be set and documented at the time of the final system test.

I. Maximum Propagation delay of the signal booster system shall be 14µs (microseconds) or as specified by AHJ.

J. The signal booster system shall include built-in automatic alarming of malfunctions of the signal booster and battery system as per NFPA 1221 Section 9.6, NFPA 72, Sections 24.5.2.6.1, and 24.5.2.6.2. Aftermarket equipment add-ons and modifications to comply with this specification will not be accepted.

K. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

01 Normal AC power
02 Signal booster trouble
03 Antenna Failure
04 Loss of normal AC power
05 Failure of battery charger
06 Low battery capacity

L. The signal booster system shall include a built-in addressable monitor module tied to the Building Fire Alarm Panel for monitoring the signal booster.

M. The vendor shall verify the system monitoring requirements with the AHJ prior to system installation. System monitoring shall be fully compliant with the AHJ requirements.

N. External filters, attachments or other aftermarket modifications of the original equipment shall not be accepted.

O. All signal booster components shall be contained in a NEMA4-type approved waterproof cabinet. All enclosures shall be painted red with signage in bright yellow or as required by AHJ

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the in-building radio system with all trades including, but not exclusive of: electrical contractor, sprinkler contractor, and HVAC/Controls Contractor. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

B. The in-building radio system contractor shall be responsible for coordinating all devices, panels and other equipment requiring 120V input power with the Electrical Contractor prior to bid. Provide a dedicated 120 volt 20 amp emergency circuit for this equipment.

C. Assembly and installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code, NFPA 70 and the National Fire Alarm and Signaling Code, NFPA 72, NFPA 1221.

D. At least two independent and reliable power supplies shall be provided as specified below.

E. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA 70 National Electrical Code, NFPA 72, National Fire Alarm and Signaling Code, and NFPA 1221.

F. The emergency responder radio coverage enhancement system shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a non-vented NEMA4 Type approved enclosure. Batteries shall be enclosed in a separate, vented NEMA 3R Type approved enclosure.

G. The signal booster shall be designed to allow degraded performance in adverse conditions, such as high temperatures in the event of heat from a nearby fire, voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) are not acceptable. External UPS (Uninterruptable Power Supplies) are not acceptable. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster, even to the extent of damaging the signal booster, as long as some communications benefit can be provided during the emergency.

H. System design shall be such that neither the failure of the normal power source, the transfer to an emergency source, nor the re-transfer to the normal source shall cause a change in system status.

I. The amplifier shall be housed in a 2-hour fire rated room or other suitable space as approved by the Engineer, or where specifically shown on the drawing.

J. Radiating cable, if used, shall be run without conduit. All other cable can be run in conduit.

K. RF Coaxial Cable shall be a fire-resistant, low-smoke type, UL classified as plenum. The classification shall be clearly marked on the outer surface of the cable regular intervals.

L. All vertical wiring for the BDA system shall be located within a 2-hour enclosure.

M. The remote annunciator shall be located adjacent to the fire alarm control panel.

N. All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and Article 760 of NFPA 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

O. All conductors shall be UL Listed FPL for LIMITED ENERGY (300 volt) and fire alarm applications and shall be installed in conduit.

P. All conductors for intelligent/addressable circuits shall be of the TWISTED/SHIELDED type to guard against outside RF interference and induced noise. Alarm and telephone communications circuits shall also be of the twisted/shielded type. Conductor size shall be determined by calculated voltage drop and circuit loading but shall not be less than #18 AWG.

Q. All wiring shall be run in a supervised fashion (i.e., no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and UL requirements.

R. Conduit and raceway system shall be installed as specified under the CONDUIT Section of the specifications, and per NEC.

S. Minimum conduit size shall be 2" EMT. Install conduit per engineered shop drawings.

3.2 TEST AND REPORTS

A. Acceptance testing for an in-building radio system is required upon completion of installation.

B. The coverage testing shall be done in accordance with NFPA 72, National Fire Alarm and Signaling Code, NFPA 1221 and as required by the local AHJ.

C. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.

D. All test records along with system diagrams, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project.

3.3 WARRANTY

A. The in-building radio system shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.

B. The equipment manufacturer shall be represented by a local organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

C. Additions required to the in-building radio system shall not affect or void any warranty to the existing system provided that said additions are installed by an authorized manufacturer's dealer. All additions to sch shall be of compatible components to match existing manufacturer's components.

3.4 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner's operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum
   01 Purpose of equipment.
   02 Principle of how the equipment works.
   03 Important parts and assemblies.
   04 How the equipment achieves its purpose and necessary operating conditions.
   05 Most likely failure modes, causes and corrections.
   06 On site demonstration.

END OF SECTION

SECTION 28 02 00

BASIC MATERIALS AND METHODS FOR SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect and Engineer for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect and Engineer.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all labor, material, tools, equipment and services necessary and required to form the complete and functioning electronic safety and security systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Security items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least seven (7) working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning Safety and Security system shall be considered a part of the overall "Scope".

H. Coordinate with other contractors on items required for the proper functioning of Safety Security system and indicated as provided by others, such as power, backboxes, conduits, sleeves, air conditioning, structural support, etc..

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. Div 1 and conditions of the contract

B. Section 08 71 00 - Door Hardware

C. DIv 26 Electrical

D. Div 27 Communications

1.4 REFERENCES

A. Americans with Disabilities Act (ADA)

B. Building Codes (UBC) (IBC), latest editions

C. National Electrical Code (NEC)

D. American Society for Testing and Materials (ASTM)

E. Underwriter's Laboratories, Inc. (UL)

F. Insulated Cable Engineer's Association (ICEA).

G. National Electrical Manufacturer's Association (NEMA).

H. Institute of Electrical and Electronics Engineers (IEEE).

I. American National Standards Institute (ANSI).

J. National Fire Protection Association (NFPA).

K. International Energy Conservation Code (IECC).

L. BICSI (Building Industry Consulting Services International)

M. Owner's Design Guidelines and Construction Standards

N. Local, county, state and federal regulations and codes in effect as of date of installation.

1.5 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

01 Approximate location of Security devices, equipment cabinets, conduits and sleeves, etc. are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such items and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

02 Communicate with the Architect and secure his approval of any location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of ceiling devices shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical, electrical, plumbing contractor may be required to allow adequate clearances for all building components. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.6 DESCRIPTION OF SYSTEM WORK

A. Furnish and install all materials, tools, equipment, and services for all electronic security/surveillance devices to provide functioning systems in accordance with performance requirements specified and any modifications resulting from reviewed shop and field coordinated drawings.

01 Access Control System

a. This system replaces the typical mechanical key-controlled door lock with a door locking system that uses an access card as the access credential.

b. The system includes an electric door-locking mechanisms, card reader located adjacent the door, door status sensor, door prop alarm and a request to exit device.

c. Typical system configuration is card or schedule-controlled entry with free exiting.

02 Intrusion Detection System

a. This system monitors areas for unauthorized entrance or intruder.

b. This system can consist of motion sensors, door status sensors, glass break sensors and one or more control keypads.
c. The keypad is used to arm/disarm system by entering a numeric code on the keypad.

03 Video Surveillance System
a. This system is used to provide video surveillance through the use of cameras of security sensitive areas and target items.
b. The system shall allow for the viewing and recording of images.

B. RACKS AND ENCLOSURES

01 Wall mounted enclosures, data gathering panels, and power supply panels shall be installed as per manufacturer's requirements.
a. Coordinate pathways and power with Electrical and Telecommunications Contractors
b. Furnish all labor, materials, tools, equipment, and services for all control consoles, equipment racks, cabinets, and enclosures not provided by others in accordance with contract documents.
c. Completely coordinate with work of other trades to avoid duplication in purchasing.
d. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.

02 Coordinate with rack/cabinet provider if it's indicated to be provided by others. Include them in scope of work if no other contractor is available or no indication that it is to be provided by others.
a. Coordinate with G.C.

03 The designated security space will provide an area reserved for rack and wall mounted security equipment.
a. The rack area allows for vertical relay rack(s).
b. Backboard wall area of 8'-0" X 8'-0" shall be reserved for wall-mounted components.

04 Provide all supplementary or miscellaneous items and devices incidental to or necessary for a sound and complete installation.

05 Drawings are representative and show general arrangement of systems and equipment, except when dimensioned or detailed.
a. For exact locations refer to dimensioned architectural drawings.
1) Field measurements take precedence over dimensioned drawings.
2) Field verify locations and arrangement of all systems and equipment.
3) Coordinate all work with other trades and Contractor.

06 Circuit Supervision
a. Supervise all signal and data transmission lines, links with other systems, and sensors.
1) Indicate circuit and detection device faults with both protected zone and trouble signals.
2) Initiate an alarm in response to opening, closing, or shorting of a signal or data transmission line.

07 Electronic Safety and Security work as specified in this Section and sub sections shall include but not limited to:
a. A project kick-off/pre-submittal meeting with the Architect, Designer, and Contractor to review security design package.
1) Additional participants shall include:

a Division 8 subcontractors

b Division 26 subcontractors

b. Preparation of pre-installation submittals, including point-to-point wiring information for security equipment to interface to work by others prior to start of any installation work. Include lock permit requests in submittals for review.
c. Furnishing and installation of all devices, components and accessories.
d. The furnishing and coordination on installation of special back boxes for equipment and field devices as required.
e. Furnishing, installation and termination of all wiring and cabling including any special purpose wire and cable for electronic safety and security systems.
    1) Coordinate all phone, network and fiber optic cable interface provided by telecommunications subcontractor or carriers.
f. Coordinate raceway and power distribution systems provided by Division 26.
g. Provide and install 12/24 VAC/DC input power to all field devices as required.
h. Coordination with other trades and Owner required to facilitate the installation of the safety and security equipment including:
    1) Division 08 (doors)
    2) Division 26 (power, raceways, and fire alarms)
    3) Division 27 (telecommunications network interface).
i. Wiring and termination of electrified door hardware by security subcontractor shall be concurrent with the installation of these electrified components by the door hardware subcontractor.
j. Programming of all security control equipment and prior coordination with the Owner's security and telecommunications personnel, unless noted otherwise.
k. Preparation of "As-Built" documentation.
l. Warranty service for completed work.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 QUALITY ASSURANCE

A. Contractor shall have a complete working knowledge of the Security system being installed.

B. Maintain a valid Type B license from the Texas Private Security Bureau.

C. Contractor shall have installed similar-sized systems in at least ten (10) other projects in the last five (5) years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document and maintain manufacturer certification for the system to be installed.

D. The security integrator must maintain an operating facility in the local area (50 mile radius) of the Project location to provide service to the Owner for the warranty period.
    01 At the Owners request for service, the security integrator shall dispatch a service technician to the location to affect the required repairs or adjustments.

E. The contractor shall maintain a spare parts inventory necessary to resolve component failures of the system.

01 Refer to individual specification section for a list of specifically required parts provided to the owner and stored on site. These parts will become the property of the owner.

02 At the end of the warranty period the Safety and Security integrator shall test the owner's spare parts and repair or replace as needed to bring the parts up to proper operation.

F. Contractor shall obtain Safety and Security system product manufacturer's certification if applicable.

G. Refer to General Conditions for other requirements.

1.9 CONTRACTOR REQUIREMENTS

A. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.

B. Contractor shall provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete Safety and system. Pay all required sales, gross receipts, and other taxes.

C. Insurance

01 The Contractor shall procure, submit for review, and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance.

02 The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.

D. Regulatory Requirements

01 Safety and Security Contractor shall supply all city, county, and state telecommunication cabling permits required by Authority Having Jurisdiction (AHJ).

02 Safety and Security Contractor shall be licensed and/or bonded as required for Safety and Security systems.

E. Privacy and Confidentiality

01 The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.

02 Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.

F. Use of Subcontractors

01 Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired.

02 The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.

G. The Contractor’s designated Project Manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications, references, and drawings) to ensure a quality installation and attend project meetings with the telecommunication consultant, the Owner and others.

H. Coordination
   01 Coordinate installation work with other trades (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways.
   02 The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for Safety and Security components.
   03 Exchange information and agree on details of equipment arrangements and installation interfaces.
   04 Coordinate with electrical contractors and plan for the pathway routes used Safety and Security cabling to minimize cable lengths.
   05 Record agreements with other trades and distribute record to other participants, Owner and telecommunication consultant.

1.10 GENERAL REQUIREMENTS

A. Upon completion of commissioning testing and Owner acceptance, DBR bears no liability or responsibility for the continued proper operation of the installed systems.

B. The Items described herein shall not be modified or substituted without consent of DBR and/or the Owner.

C. Electronic Safety and Security systems integrator (Safety and Security subcontractor) manager/supervisor shall attend meetings arranged by the Contractor, Architect, Owner or other parties affected by the work of this Section.

D. If the manufacturer of Safety and Security devices or connecting hardware has supplied post manufacture performance data, copies of such are to be kept for inclusion in the documentation and made available to the Owner upon request.

E. All materials are to be new unused and of the latest series of model number, unless otherwise indicated by the Owner or Safety and Security system designer.

F. All Safety and Security integrator personnel must be manufacturer certified and capable of an installation that falls under the manufacturer's guidelines necessary to obtain a manufacturer warranty.
   01 The integrator shall provide all components/materials essential for a complete and functional Safety and Security access and surveillance system.

G. Safety and Security integrator shall issue a 2-year warranty on installation and workmanship.

H. These Specifications and Drawings are intended for bidding purposes only; no part shall be copied or used for any purpose other than bidding on this project.
   01 This package shall be contractual upon bid award.

I. Drawings and Specifications are to be used in conjunction with one another and to supplement one another.

01 In general Specifications determine the nature and quality of the materials and tests, and drawings establish the quantities, details and give characteristics of performance that should be adhered to in the installation of the Safety and Security system components.
02 If there is an apparent conflict between the drawings and specifications, or within the specifications themselves, the items with greater quantity or quality shall be estimated and installed.
03 Clarification with the Owner/Designer about these items shall be made prior to purchase and installation.
04 Questions regarding the Specification or system requirements should be directed in writing to DBR or the Owner.

J. Safety and Security integrator shall adhere to Division 1 general requirements and written Safety and Security Specifications and Drawings within this construction package and shall be responsible for complying with all local, state and federal laws or regulations applicable to the work being performed, even though said law, rule or regulation is not identified herein.

K. Safety and Security integrator shall arrange and pay for any inspections required by the public agencies having jurisdiction in the area.

L. The Safety and Security contractor shall procure and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or conjunction with, the performance of the work hereunder by the Safety and Security integrator, his agents, representatives, or employees.
01 The Safety and Security integrator shall pay the cost of such insurance.

M. The Safety and Security integrator will respect and protect the privacy and confidentiality of the Owner, his employees, processes, products, and intellectual property to the extent necessary, consistent with the legal responsibilities of the State of Texas and the Owner.

N. If required the Safety and Security integrator shall sign a non-disclosure agreement and abide by its requirements to keep confidential all information concerning bid documents and this Project.

O. Furnish submittals and manuals in accordance with Division 1.

P. Furnish a detailed material list complete with suppliers (distributors) list of components and distributors name, address, and phone number.

Q. Refer to Specifications issued by Architect, Division 1, for Project and cost payments.

1.11 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.12 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.14 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

01 A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

02 An index page with a listing of all data included in the Submittal.

03 Product Data and Shop Drawings shall be submitted in separate submittals, to avoid rejection of one due to errors in the other.

B. Shop Drawings

01 Safety and Security Contractor shall submit, for approval, floor plans that identify all device locations, device ID, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.

02 A functional description of each system.

03 All cable and wiring types for each device type used.

04 Certification that lock wiring and access control systems requirements have been coordinated with electrified door hardware, fire alarm systems, automatic door controls, and overhead door controls specified in other sections and other packages.

05 Riser diagram showing routes between floors or other areas that are not easily identified on the floor plans.

06 Safety and Security One-line diagrams showing all input and output points of the system.

a. The Contractor shall make any corrections required by the consultant team, file with him two corrected copies and furnish such other copies as may be needed.

07 Power supply points listing with devices and maximum loads to prevent overloading.

08 Equipment schedules listing all system components, manufacturer, model number and quantities of each.

09 Safety and Security Contractor shall submit, for approval, diagrams that show Safety and Security equipment layouts, rack layouts (including wall and rack elevations), cabling riser and interconnection diagrams, etc.

10 Safety and Security Contractor shall submit, for approval, labelling scheme for all Safety and Security devices and cabling components (faceplates, horizontal cables, riser cables, inter-building cables, racks, patch panels, etc.) installed.

11 The Contractor shall make any corrections as required by the Engineer and submit revised shop drawings to the team for approval.

12 Approval by the Engineer of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. Requests to deviate shall be submitted in writing to the Architect.

13 Drawings shall show the proposed firestop systems and locations, (stamped/embossed by the PE) to restore/maintain the designed fire rating of the building structure (walls, ceilings, floors, etc.).

14 Shop Drawings shall be newly prepared and not reproduced from the Contract Documents. Drawings shall be prepared by a draftsman skilled in this type of work. Submitting copy of the engineering drawings or engineering drawings with contractor's markup as shop drawings is NOT ACCEPTABLE.

15 Shop drawings shall be developed in coordination with other trades (MEP, Architecture, Structural, etc.) to avoid any collision or conflict and to meet all industry standards best practices, codes and regulation requirements. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified

16 Additional coordination with other trade contractors may be required to allow adequate clearances and meet code requirements. All transitions, offsets and relocations as required by actual field conditions shall be performed by the contractor at no additional cost to the owner

C. Product Data Submittals

01 Safety and Security Contractor shall submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection.

02 Safety and Security Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.

03 Inlcude battery backup calculations to show load and back-up times for UPS and power supplies with batteries.

04 Include licenses and permit required, and qualifications and proof of work history (with references).

05 All data sheets shall be organized by specification sections and provided with table of contents. All products required shall be included in one submittal.

06 All product substitutions shall be submitted in advance for review and approval before being included in product submittal package.

07 Specification variations pages with a listing of all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then the specification page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

08 Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

09 Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

10 Identification of each item of material or equipment matching that indicated on the Drawings.

11 Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

12 Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT”.

D. Warranty

01 The Safety and Security Contractor shall submit appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty.

02 All subsequent work shall be in accordance with approved submittals. The Safety and Security Contractor shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer’s warranty registration qualification procedures that would disqualify any part or all of the system from that warranty qualification.

E. Qualifications

01 Safety and Security Contractor shall submit a list of the Contractor’s previous projects that demonstrate qualification for this project. This list shall include, but not be limited to:

a. At least ten (10) other projects in the last five (5) years
b. Name and location of project
c. Project contacts, email addresses, and phone numbers
d. Total square footage
e. Total number of devices
f. Types of system platform

02 Safety and Security Contractor shall submit an up-to-date and valid statement of qualifications for those assigned to perform the work specified herein at time of bid submission.
a. Safety and Security Contractor Employees
b. Subcontractors

03 Manufacturer certifications for Contractor and installers.

F. Samples

01 Provide sample of all visible devices such as camera mount, motion detectors, card reader, door contact, etc. for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color selection before purchasing materials.

G. Refer to Division 1 for additional information on shop drawings and submittals.

H. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

I. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

J. Submittals shall be reviewed and returned to the Contractor with one of the following categories indicated:

01 REVIEWED: Contractor does not need to take further submittal action, shall include this submittal in the O&M manual, and verify with Architects and other parties (Owner, etc) reviewing the submittals that no other correction is required before placing orders and starting installations.

02 REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted, and verifed with Architects and other parties (Owner, etc) reviewing the submittals that no other correction is required before placing orders and starting installations.

03 NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

04 REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

05 CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

06 MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

K. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

L. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

M. Furnish detailed shop drawings, descriptive literature, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:
01 Fire Alarm System
02 Access Control System
03 Video Surveillance System
04 Intrusion Detection System

N. Refer to each specification section for additional requirements.

1.15 COORDINATION DRAWINGS

A. Before submit shop drawings, Contractor shall prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
01 Indicate the proposed locations of Safety and Security conduits/sleeves, pullboxes, equipment, cabinet and other materials. Include the following:
a. Wall and type locations.
b. Clearances from other building structure and MEP equipment.
c. Clearances for servicing and maintaining equipment and cabling, and space for equipment disassembly required for periodic maintenance.
d. Equipment connections and support details.
e. Exterior wall and foundation penetrations.
f. Fire-rated wall and floor penetrations.

g. Sizes and location of required concrete pads and bases.
h. Structural floor, wall and roof opening sizes and details.

02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: cable routing, equipment location, clearance, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.16 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:

01 Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

02 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

03 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

04 Servicing instructions and lubrication charts and schedules.

05 Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 28, include the following information for equipment items:

a. Identifying names, name tags designations and locations for all equipment.
b. Fault Current calculations and Coordination Study.
c. Reviewed shop drawing submittals with exceptions noted compliance letter.
d. Fabrication drawings.
e. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
f. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
g. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
h. Equipment name plate data.

i. Wiring diagrams.
j. Exploded parts views and parts lists for all equipment and devices.
k. Color coding charts for all painted equipment and conduit.
l. Location and listing of all spare parts and special keys and tools furnished to the Owner.
m. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

06 The Safety and Security Contractor shall deliver the Installer's Warranty and Manufacturer's signed System Warranty.
a. Delivery shall be completed within two (2) weeks of the time of final punch list review.
b. Product Certificates shall be signed by manufacturers certifying that products furnished comply with requirements.

07 Testing Report Requirements
a. Submit certified test reports of Contractor-performed tests. Contractor shall submit the required Test Reports in the format and media specified, upon completion of testing the installed system.
b. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
c. Three (3) sets of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable designations.

08 Supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

1.17 RECORD DRAWINGS

A. Maintain a continuous record during the course of construction of all changes and deviations in the work from the contract drawings. Upon completion of the work, purchase a set of "Auto Positive Tracings" on vellum and make corrections as required to reflect the electrical systems as installed. Location and size of all conduit shall be accurately shown to dimension. Submit three prints of the tracings for approval. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. Record drawings shall be furnished in addition to shop drawings. Symbols on the Record drawings shall correspond to the identification symbols on the contract drawings and equipment identification plates and tags.

B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed device and cabling, and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

E. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

F. When the option described in paragraph E., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS
DATE:
(NAME OF GENERAL CONTRACTOR)
BY:_____
(SIGNATURE)
(NAME OF SUBCONTRACTOR)
BY:_____
(SIGNATURE)

1.18 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 28.

1.19 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 28 Sections for additional Operator Training requirements.

1.20 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.21 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. See requirements in Division 1 Specifications.

C. The Security Integrator shall warrant all completed work, including all materials and labor, to be free from defects in design, workmanship, and/or materials for a period of two (2) years from final acceptance date.
   01 System acceptance is defined as the completion of all functional performance testing and the resolution of all punch list items.

D. Warranty Service
   01 In the event that defects in the materials and/or workmanship are identified during the warranty period, the contractor shall provide all labor and materials to correct the deficiency.
   02 All service work shall be performed by factory certified technicians.
   03 All warranty service shall include the replacement of all parts and or components as required to restore normal system operation.
      a. If parts or components need to be repaired, a loaner will be supplied and installed until the part or component can be repaired and reinstalled.
   04 Immediately following a warranty service request, the Contractor shall provide written documentation to Owner which details the service work completed, cause of trouble, and any outstanding work required to restore a complete and normal system.

E. Warranty service requests shall be responded to within 4 hours of notification with a qualified service technician on site.

F. All repairs shall be completed within 48 hours upon site arrival.
   01 If the failure exceeds 48 hours, the Owner reserves the right to require the contractor provide on-site manufacturer support at no additional cost to Owner.

G. Extended warranties on equipment components offered by the manufacturer shall be passed through to the Owner.

01 Warranty provisions shall be fully transferable only at the direction of the Owner, in the event that ownership of the installed security systems is transferred.

1.22 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.
   01 It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
   02 If the client, Architect or Owner of the project requires electronic media for "record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.
   03 At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

1.23 PRE-INSTALLATION MEETINGS

A. Safety and Security Contractor shall attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section. This venue is to ask and clarify questions in writing with consultant and/or project manager/Owner representative.
   01 Agenda

a. Safety
b. Work to be performed
c. Scheduling
d. Coordination
e. Other topics as necessary

02 Attendance
a. Safety and Security project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.
b. All individuals who will serve in an on-site supervisory capacity, including project managers, site supervisors, and lead installers, shall be required to attend the pre-installation conference.
c. Individuals who do not attend the conference will not be permitted to supervise the installation and testing of Safety and Security cables on the project.

1.24 CONTRACT ADMINISTRATION

A. The Engineer may perform site visits and provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.

B. Job Field Report outline:
01 General: The general installation progress in relation to scheduled work made by the Contractor up to that date.
02 Deficiencies and/or Items of Note: Documents observations of the cable installation that may require corrective action by the Contractor.

1.25 POST INSTALLATION MEETINGS

A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc.

B. Attendees shall include
a. Safety and Security Contractor
b. Project Manager/Owner Representative
c. General Contractor
d. Safety and Security Engineer.
e. Other trades that the GC deems appropriate.

C. At this meeting the Safety and Security Contractor shall present and explain all documentation.

D. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Safety and Security Contractor and resubmitted within one (1) week of the meeting.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:
   01 Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
   02 Alternate equipment must be equal from the standpoint of materials, construction and performance.
   03 Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 GENERAL REQUIREMENTS

A. All materials and products used on this project shall be listed by Underwriters' Laboratories.

B. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of Safety and Security cabling products and shall be the manufacturer’s latest standard design in satisfactory use for at least one year prior to bid opening.

C. All material and equipment, as provided, should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products.
   01 All shall be typical commercial designs that comply with the requirements specified.
   02 All material and equipment shall be readily available through manufacturers and/or distributors.

D. Installer is to comply in every way with the requirements of local laws, ordinances, and rules, the National Board of Fire Underwriters, and the National Electrical Code.

E. In the event of any conflicts between documents referenced herein and the contents of this specification, the Installer is to notify in writing to the Architect/Engineer of any such occurrences before the purchasing of any equipment, materials and/or installation by the Installer. The Architect/Engineer will notify the Installer of any actions required to resolve these conflicts.

F. No change in the plans or in the specifications is to be made without written instruction to do so from the Owner or Architect/Engineer.

G. Materials are to be installed in accordance with manufacturer’s recommendations and best industry practices.

H. The Installer is to promptly correct all discrepancies and/or defects for which the Installer is responsible.

I. The Installer is to maintain a set of working specifications and drawings on site at all times and to make this set available for inspection during site visits.

J. All materials are to be new and of the highest quality.

K. All products installed in the above ceiling space are to meet or exceed the Underwriters Laboratories (UL) fire rated cable insulation requirements and are to be Plenum rated.

L. The Installer is to seal ALL penetrations, conduits, sleeves, cable trays, etc., where cabling has been installed through rated walls/floors with Wiremold Flamestopper intumescent fire-stop system (or approved equivalent) where they pass through rated walls. The Installer is responsible for returning any and all penetrations through rated walls or floors made for Safety and Security cable to their pre-penetration rating.

01 All material used to dress cable bundles shall be applied loosely to allow the dressing material to slide around the bundle. Tension of dressing materials shall not deform the cable sheath. Dressing materials should be limited to the Safety and Security rooms only. Cabling shall be placed unbundled in cable tray and/or j hooks in the above ceiling spaces. No bundling materials are to be used above ceiling. All j hooks installed shall include the corresponding clip provided by the hook manufacturer. Plastic cable ties will not be permitted.

M. Any discrepancy in the contract documents is to be remedied by the Installer providing and installing the newer, greater quality or quantity of the item or items in question.

N. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

O. Provide nylon bushings for all conduit openings.

P. All horizontal cables not in a cable tray or conduit shall be supported at a maximum of 48 to 60 inch intervals. Cable support system is to be independent of supports for other trades. At no point shall cable(s) make contact with acoustic ceiling supports, grids, panels, electrical conduits, water pipes or HVAC ductwork or supports.

Q. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the installer prior to final acceptance at no cost to the Owner.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

01 Plaster Surfaces: Milcor Style K.
02 Ceramic Tile Surfaces: Milcor Style M.
03 Drywall Surfaces: Milcor Style DW.
04 Install panels only in locations approved by the Architect.

2.4 FIRE STOPPING

A. Contractor shall restore the fire rating of penetrations to rated walls, ceiling, flooring after cable pulling. Fire stopping products shall be as follows:

01 Hilti
02 SpecSeal
03 3M
04 Owner approved alternate

2.5 IDENTIFICATION (LABELING) SYSTEM

A. Contractor shall label al communications system components installed. Labeling products shall be as follows:
   01 Brady (LAT-19-361-4)
   02 Dymo
   03 Hellerman-Tyton
   04 Owner approved alternate

2.6 ESCUTCHEONS

A. Provide heavy chrome or nickel-plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.7 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.8 PAINTING

A. All factory assembled equipment shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements
   01 Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

B. Established Dimensions
   01 Where field measurements cannot be made without delaying the work, coordinate with the General Contractor to establish dimensions.
   02 When approved in writing, proceed with fabricating units without field measurements.
   03 Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

C. Pre-installation inspection

01 The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.

02 Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.2 DEMOLITION AND REMODELING

A. Where only portions of the existing Safety and Security system are to be modified as part of the renovation and addition project, devices related to or part of this system outside of the renovation area shall be kept in operations.

B. The Drawings do not show all demolition work required. The Contractor shall make himself familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.

C. Utility service outages required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two (2) weeks in order to schedule required outages. 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.

D. The contractor shall perform a preconstruction walk thru of the site to observe and test the existing systems for operation. The owner assumes that the system is 100% operational and functioning prior to the commencement of construction. If any portion of the system observed or tested to be non-functional or inoperable at the commencement of the project will be noted by the contractor. A written report will be generated by the contractor noting their findings and submitted to the project team for review and handling. The owner will determine if the items found to be non-functional are to be repaired by contractor or repaired by the owner. If this repair of the equipment found to be non-functional is to be added to the contractor’s scope of work the contract amount for the Work shall be adjusted accordingly.

E. Work Sequence and Timing. The Owner will cooperate with the Contractor; however, the following provisions must be observed:

01 During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, Safety and Security, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.

02 A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors and Sub-subcontractors, and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

F. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing safety and security devices and headend equipment. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

G. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

H. All equipment and/or systems noted on the Drawings "To Be Removed" should be removed including, associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

I. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility; or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

J. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

K. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

L. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.

M. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage which occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

N. When applicable, Include in the contract price all rerouting of existing backbone cabling, , etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing Safety and Security rooms in areas scheduled to remain operational with a minimum of interruption.

O. All existing cabling, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

P. Cabling and equipment serving Safety and Security system which is to remain but which is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

Q. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

R. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

S. Field verify measurements, and cabling arrangements are as shown on Drawings.

T. Verify that scheduled cabling and equipment serving only those abandoned devices to be demolished and removed in its entirety.

U. Demolition Drawings are based on casual field observation and existing Record Documents. Report discrepancies to Architect and Engineer before disturbing existing installation.

V. Beginning of demolition means that the contractor accepts existing conditions.

W. Demolish and extend existing Safety and Security work under provisions of Division 02 and this Section.

X. Remove, relocate, and extend existing systems to accommodate new construction.

Y. Remove abandoned cabling to source of origination point. Remove racks and other equipment as scheduled on the drawings.

Z. Remove exposed / abandoned cabling systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.

AA. Repair adjacent construction and finishes damaged during demolition and extension work.

BB. Maintain access to existing systems which remain active. Modify installation or provide access doors as appropriate.

CC. Extend existing systems using materials and methods compatible with existing systems, or as specified.

DD. Clean and repair existing materials and equipment which remain or are to be reused. The Contractor shall modify, remove, and/or 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 the property of the Owner, and shall be delivered to such destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operating condition. The Contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

EE. 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 and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

FF. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

GG. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points 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 disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done 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 approval of the Owner as hereinbefore specified.

HH. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all electrical services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

II. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

JJ. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction.

3.3 INSTALLATION

A. General
   01 Contractor shall install work in accordance with specifications, drawings, manufacturer’s instructions and approved submittal data.

B. Allowable cable bend radius and pull tension:
   01 Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
   02 After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.

C. Pull Strings
   01 Provide pull strings in all new conduits, including all conduits with cable installed (trailer strings) as part of this contract.
   02 Data and video cables can be pulled in tandem with pull strings.
   03 The pull strings must move freely to prevent cable jacket/cable damage during pulls.

3.4 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3” of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.5 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of Electronic Safety and Security work shall be concealed in walls, chases, under floors and above ceilings except:
   01 Where shown to be exposed.
   02 Where exposure is necessary to the proper function.

3.6 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2-hour UL approved fire sealant manufactured by “3M” or approved equal.

3.7 LABELING

A. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

B. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.

C. Provide transparent plastic label holders, and 4-pair marked colored labels.

D. In accordance with ANSI/TIA-606-B "Administration Standard for Commercial Telecommunications Infrastructure":
   01 Install colored labels according to the type of field as per color code designations.
   02 Use “designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields”.

E. Pathway Labels and Labeling System
   01 Labeling system shall consist of a hand-held portable printer

02 Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive. Label size shall be appropriate for the conduit size. Font size shall be legible from the finished floor.

03 Inner duct: Polyethylene general-purpose tagging material attached using tie wraps.

04 Junction boxes: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name. Font size shall be easily visible from the finished floor.

05 All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.

06 Identification

a. All conduits, junction boxes, gutters, and pull boxes shall have machine-generated labels easily visible from the finished floor.

b. Conduits shall be labeled with the word “Security” and the conduit’s origination room number and destination room number.

c. The Contractor shall label conduit at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other sections.

d. Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by contractor and submitted for approval.

e. The Contractor shall label conduit sleeves at each wall and floor penetration.

3.8 FIRESTOPPING

A. Provide approved fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for Safety and Security cabling system.

B. Install and seal penetrations (conduit, sleeves, slots, chases) in fire-rated barriers created for Safety and Security infrastructure to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.

C. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.

D. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.

E. Using a “ring and string” method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner in writing. Code-compliant firestopping rules still apply.

F. Coordinate firestopping procedures and materials with General Contractor.

G. Sharing the pathway of other trades/utilities through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.

H. Provide and install removable, intumescent mechanical systems in floor chases for all openings greater than 0’-4”.

I. Provide and install removable, intumescent, firestop bricks for all openings greater than 0’-4” where there are penetrations through walls.

J. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers’ specifications.

K. Provide manufacturer recommended material for rated protection for any given barrier.

L. Laminate and permanently affix adjacent to chases the following information:
   01 Manufacturer of firestop system.
   02 Date of installation/repair.
   03 Part and model numbers of system and all components.
   04 Name and phone numbers of local distributor and manufacturer's corporate headquarters.

M. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.

N. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.

O. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

P. Develop training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

Q. Within the normal environment, the installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

R. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in structure cable system capacity.

S. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.

3.9 WALL MOUNTED EQUIPMENT

A. Install all wall mounted equipment in accordance with the National Electrical Code, industry standards and as shown on the drawings.

B. Unless noted otherwise, all wall mounted equipment that need to be accessed for operation or maintenance shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices(note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.10 CLEANING

A. The Contractor will clean all surfaces of equipment and devices prior to final acceptance by Owner.

3.11 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.12 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

01 At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.

02 All devices, equipment, and equipment cabinets/enclosure shall be cleaned and in operating condition.

03 Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.

04 Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.

05 After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

3.13 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.

B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

END OF SECTION

SECTION 28 05 00

BASIC MATERIALS AND METHODS FOR FIRE ALARM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons, therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.

E. All discrepancies within the Contract Documents discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each, and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

J. Refer to 260313 for demolitions requirements.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA)

E. National Electrical Manufacturer's Association (NEMA)

F. Institute of Electrical and Electronics' Engineers (IEEE)

G. American National Standards Institute (ANSI)

H. National Fire Protection Association (NFPA)

I. International Energy Conservation Code (IECC)

1.6 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

01 Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.

02 Communicate with the Architect and secure his approval of any outlet (light fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of light fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:

a. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.

b. 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.

c. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by ASHRAE Fundamentals Handbook, chapter 39 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

01 A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

02 An index page with a listing of all data included in the Submittal.

03 A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.

04 Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

05 Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

06 Identification of each item of material or equipment matching that indicated on the Drawings.

07 Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

08 Additional information as required in other Sections of this Division.

09 Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

01 REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.

02 REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

03 and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

04 REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.

05 CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.

06 MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Furnish detailed shop drawings, descriptive literature, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

01 Fire Alarm System

02 Intrusion System

I. Refer to each specification section for additional requirements.

1.13 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
   01 Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
   02 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   03 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   04 Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   01 Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
      a. Wall and type locations.
      b. Clearances for installing and maintaining insulation.
      c. Locations of light fixtures and sprinkler heads.
      d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      e. Equipment connections and support details.
      f. Exterior wall and foundation penetrations.
      g. Routing of storm and sanitary sewer piping.
      h. Fire-rated wall and floor penetrations.
      i. Sizes and location of required concrete pads and bases.
      j. Valve stem movement.
      k. Structural floor, wall and roof opening sizes and details.
   02 Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
   03 Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
   04 Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 26 and Division 28.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

E. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

F. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS
DATE:
(NAME OF GENERAL CONTRACTOR)
BY:_____
(SIGNATURE)
(NAME OF SUBCONTRACTOR)
BY:_____
(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26 and Division 2, include the following information for equipment items:

01 Identifying names, name tags designations and locations for all equipment.
02 Reviewed shop drawing submittals with exceptions noted compliance letter.
03 Fabrication drawings.
04 Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
05 Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
06 Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
07 Equipment name plate data.
08 Wiring diagrams.
09 Exploded parts views and parts lists for all equipment and devices.
10 Color coding charts for all painted equipment and conduit.
11 Location and listing of all spare parts and special keys and tools furnished to the Owner.
12 Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

01 It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

02 If the client, Architect or Owner of the project requires electronic media for "record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

03 At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

01 Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.

02 Alternate equipment must be equal from the standpoint of materials, construction and performance.

03 Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 UL LISTING

A. All materials and products used on this project shall be listed by Underwriters' Laboratories.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
   01 Plaster Surfaces: Milcor Style K.
   02 Ceramic Tile Surfaces: Milcor Style M.
   03 Drywall Surfaces: Milcor Style DW.
   04 Install panels only in locations approved by the Architect.

2.4 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.5 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.6 PAINTING

A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.7 RACEWAY IDENTIFICATION

A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Use red banding with black lettering except as otherwise indicated. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, on pull boxes, on junction boxes and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction and at spacings of not more than 50 feet along each run of conduit.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. Identification of Equipment:

01 All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.

02 Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters' Laboratories, Inc.), and approval labels are exceptions to this requirement.

03 Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

04 Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed.

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. All work shall comply with OSHA Standards.

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:
   01 Where shown to be exposed.
   02 Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by “3M” or approved equal.

D. Refer to 26 05 33 for additional requirements.

3.4 CONTROL PANELS

A. Install all Panels in accordance with the National Electrical Code, industry standards and as shown on the drawings.

B. Panels mounted in telecom, MDF, IDF, mechanical/electrical rooms shall be mounted at a working height not requiring a ladder when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

3.5 CLEANING

A. Touch-up and refinish scratches and marred surfaces on panels.

3.6 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4X stainless steel or fiberglass reinforced enclosures for contactors, panel boards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.7 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division 01.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection
   01 At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
   02 Panels shall be cleaned and in operating condition.
   03 Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.
   04 Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
   05 After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

END OF SECTION

SECTION 28 10 00

ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY/OVERVIEW

A. This section provides specifications for the installation of Electronic Access Control (AC), and related components.

B. Related Sections
   01 Section 08 71 00 - Door Hardware
   02 Section 26 00 00 - Electrical (including related sub-sections)
   03 Section 27 02 00 - Basic Materials and Methods for Communications Systems (including related sub-sections)
   04 Section 28 02 00 - Basic Materials and Methods for Safety and Security Systems
   05 Section 28 20 00 - Video Surveillance System
   06 Section 28 31 00 - Intrusion Detection System
   07 Section 28 46 00 - Fire Alarm and Smoke Detection

1.2 REFERENCES

A. See Section 28 02 00.

1.3 SYSTEM COORDINATION

A. The Security Integrator shall completely coordinate all relevant work of other trades/systems including, but not limited to:
   01 Door Hardware
   02 Fire Alarm System
   03 Electrical Systems(s)
   04 Telecommunications System(s)

B. Electric Locking Mechanisms
   01 The security integrator and door hardware contractor shall coordinate all door hardware, door and door frame design.
   02 The security contractor shall verify all specified door hardware is appropriate for the security application and verify the sequence of operations for each access controlled opening.

C. Fire Alarm and Life Safety
   01 The security integrator shall coordinate the access control system design with the life safety consultant to insure compliance with applicable codes and requirements.
   02 This includes, but is not limited to:
      a. Fire alarm interface
      b. Fail safe/fail secure locking mechanisms
      c. Delayed egress

1.4 GENERAL SYSTEM DESCRIPTION

A. General Requirements

01 Furnish all labor, materials, tools, equipment, and services for a complete security system as indicated and in accordance with provisions of the contract documents.
02 Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.
03 Comply with the provisions of Division 1 for General Requirements.
a. In the event of a conflict between the provisions of this Section and Division 1, the more stringent provisions shall apply.
04 All system devices and components included shall be compatible.

B. The project shall be equipped with new system that is maintained by the police department.
01 All work required within the project for new AC system head end shall be furnished and installed by the project security contractor.

C. The AC system will support the needs of the project in accordance with these specifications.

01 The AC system shall have the capability for future expansion to support the security needs of the completed complex.

D. The AC system shall be interfaced with the Fire Alarm system (by others) as required to comply with all building code requirements.

E. Emergency/UPS power will be utilized to power the AC system's computer workstation (client) at the Security head end equipment location.

F. Emergency/APS power will be utilized to power the AC system's Data Gathering Panels and control components as required throughout the facility.

1.5 ACCESS CONTROL SYSTEM

A. The AC system will consist of card readers, door position switches, and request-to-exit sensors operating in conjunction with associated electric door hardware.
01 Card readers and adjunct devices shall be provided as shown on the drawings.
a. Provide card readers, Data Gathering Panels (DGP), and alarm input and output devices connected to the security management system via Local Area Network (LAN).
b. The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided device, the location to be installed, and the port configuration needed for communication.
c. Furnish all labor, materials, tools, equipment, and services for a complete system as indicated and in accordance with provisions of the contract documents.
d. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.

B. Card readers will work such that upon presentation of a valid AC card, the unique card data shall be transmitted to an associated control panel where the data is compared to an authorized user database and access is approved or rejected accordingly.
01 A valid authorization will activate operation of the electric lock and shunt the door position switch. The alarm shunt will not affect supervision of the detection circuit.
02 Coordinate with owner on card format and other pertinent details.

C. Card readers shall support Magnetic Stripe, 125 KHz proximity, and 13.56 MHz smart card technologies

D. Door position switches at card reader controlled location serve to indicate the open/closed status of the associated door and shall establish the basis for reporting a door-propped or unauthorized entry condition.
   01 Security contractor is responsible for coordinating the contact configuration (SPDT) (DPDT) and rating for door position switches, and for connection of switches with the AC.
   02 The Division 08 contractor shall be responsible for providing all flush mounted door position switches as indicated on drawings.

E. Electrified door hardware for card reader controlled doors will include electrified locksets, electric exit devices, and electric power transfer as shown on the drawings.
   01 All electrified door hardware shall be provided under the work of Division 08 unless otherwise noted.
   02 Security subcontractor shall provide all security cables and, low voltage power supplies for operation of electrified door hardware associated with card reader controlled doors.

F. Request-to-exit (REX) devices at designated card reader controlled doors shall cause the associated door position switches to be shunted.
   01 The alarm shunt shall not affect the supervision of the alarm detection circuit.
   02 Electrified Lockset shall have an integral REX switch.
   03 Electrified Exit devices shall have an integral REX switch.
   04 Magnetic Locks shall have a Passive InfraRed (PIR) motion sensor REX device.
      a. Wire the PIR to the Door REX Input. The configuration on this motion shall be non-resettable and activate for only 2 seconds.
      b. A second set of output contacts for the REX motion sensor shall be wired in series with the power to the lock, disconnecting power to the lock when motion is sensed.
      c. The PIR REX shall be mounted and the sensor positioned to avoid detection more than three feet from the door and at the door bottom sweep.
         1) Deter under door spoofing attacks by pointing the sensor away from the door threshold. Position the sensor to detect motion at the door handle or door push plate.
      d. Connect to REX switch in exit device (by Division 8).
         1) Coordinate with Division 8 to ensure proper REX switch configuration
         2) Wire the REX switch as described for the above motion sensor to disconnect power to the lock and activate the REX input on the DGP.
      e. Doors with out exit devices, a UL listed double pole pushbutton exit switch shall be provided as a redundant REX device.
         1) It shall be wired as described for the above motion sensor to disconnect power to the lock and activate the REX input on the DGP.
         2) Locate within 6’-0” of the door push-plate/handle.

1.6 SUBMITTALS

A. Follow provisions of Section 28 02 00 for additional requirements.

B. Field Test Reports

01 Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments made to each/any component and all field tests performed to prove compliance with the specified performance criteria.
02 Indicate and interpret test results in written form and verbally to owner/DBR for compliance with performance requirements at a pre-scheduled meeting.

C. Battery calculations to show the expected loads and backup duration for power supplies and UPS devices for all active AC equipment.

D. Security Contractor is responsible to prepare and submit as required to the Authority Having Jurisdiction (AHJ) any and all information to obtain an Electronic Locking Mechanisms permit.

1.7 QUALITY ASSURANCE

A. Follow provisions of Section 28 02 00.

B. Spare Parts:
01 Provide two (2) spare components for every model and configuration of electronic components and devices used on the project as spare parts inventory.
a. The security integrator will turn over the new and unused components and devices to the owner at project closeout.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow provisions of Section 28 02 00

1.9 PROJECT/SITE CONDITIONS

A. Follow provisions of Section 28 02 00

1.10 WARRANTY

A. Follow provisions of Section 28 02 00

B. All devices and components shall comply with applicable U.L. standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SYSTEM MANUFACTURERS

A. AC System Platform Software
01 Owners Existing Open Options DNA Fusion Platform

B. System Platform Server (By Owner)

2.2 ACCEPTABLE ACCESS CONTROL MANUFACTURERS

A. Access Control Data Gathering Panels (DGP)
01 Open Options Inteliigent Controller LP1502 (SSP-D2)
02 Owner Approved Equivalent

B. Access Control Door Controllers (Sub Controllers)
01 Open options MR52-S3 (RSC-2)

02 Or Owenr Approved Equivalent

C. Input Control Module
01 Open options MR16IN-S3 (ISC-16)
02 Or Owner Approved Equivalent

D. Proximity Card Readers (CR)
01 Wall Mount Schlage MT15
02 Mullion Mount Schlage MT11
03 Owner Approved Equivalent

E. ID credentials- Provide 500 credentials. Coordinate exact requirments with owner prior to ordering.
01 Schlage 7610T (FOB)
02 Owner Approved Equivalent

F. Lock Down Button
01 STI Lock Down Button SS2242LD-EN
02 Or owner approved equivalent

G. Intercom Door Station
01 AIPhone IX-DV
02 Master Station IX-MV7-HB
03 Or Owner approved equivalents

H. Door Release Button
01 RCI 909 Rocker Switch
02 Or owner approved equivalent

I. Door Position Switches (DPDT)
01 Concealed Magnetic Door Position Switch
a. Schlage
b. Sentrol 1076D
c. Magnasphere MSS-19C/L / MSS-25C/L
d. Detection Systems, Inc
e. Owner Approved Equivalent

J. Electric Locking Mechanism Power Supply
01 LifeSafety Power
02 Owner Approved Equivalent

K. Electric Locking Mechanisms (By Division 08)

L. Electric Power Transfer (By Division 08)

M. Wire & Cable
01 Belden
02 Windy City
03 General Cable
04 Owner Approved Equivalent

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Power Supplies
- 01 Power supply requirements
  - a. A switch and on/off indicator within the power supply cabinet.
  - b. Four hours of sealed gel battery backup to provide continuous operation during power failure.
    - 1) Provide batteries as required to provide specified battery backup time for a fully loaded power supply, regardless of the connected load.
  - c. A battery charger to maintain the battery.
  - d. Low battery and power fail contacts to monitor the status of the input power and the battery.
    - 1) Connect each power supply low battery and power fail alarm as a separate alarm input into DGP.
  - e. Key lockable wall mount metal enclosure with tamper switch.
- 02 Additional Electric Locking Mechanism Power Supply Requirements
  - a. It is within security contractors resposibility to review division 8 door hardware specification and determine power requirement of electric locking mechanism for each access controlled door. Power supplies are to sized to accomadate power requirments of all electrified hardware plus an additional 25% for potential future growth.
  - b. Fail secure electric locking mechanisms shall remain locked during power failure and fire alarm conditions.
  - c. Connect fail safe locking devices in accordance with applicable life safety codes to unlock automatically under the following conditions:
    - 1) Loss of power to the power supply
    - 2) Failure of the power supply
    - 3) Fire alarm activation
  - d. Provide power distribution boards with independently fused output relays and fire alarm control panel interface.
- 03 Additional Device Power Supply Requirements
  - a. Provide device power supplies for other security system devices requiring power (e.g. card readers, local alarms, motion sensors, etc.)
  - b. Power Supplies are to be centralized in MDF/IDF rooms.
  - c. Provide power distribution boards with independently fused outputs.

B. Video Surveillance System Integration
- 01 Automatic Video Call-up
  - a. All alarms shall call up all cameras in the area of alarm to the screen of the ACID alarm operator workstation to allow for operator assessment of the alarm.
- 02 Pre and Post Alarm Video
  - a. The operator shall be able to view up to 10 seconds of video before the alarm and 30 seconds after the alarm for all cameras associated with the alarm.
  - b. This feature is to be integrated with the operator alarm notification to assist in alarm assessment.
  - c. This feature shall be displayed as an option on the alarm notification screen and will not require operator to make a manual video search.
- 03 Recording
  - a. All cameras whose field of view that include images of the area affected by the alarm, shall be recorded when an alarm is detected for use in forensic analysis, including the pre and post alarm video.

04 Duress and Emergency Intercommunications Integration
a. Calls from emergency intercoms/phones with cameras shall provide the above video call-up and the pre and post alarm video capabilities.

C. Tamper Resistant Screws
01 Provide appropriate screw heads for each application (e.g. countersunk heads for recessed cover plate screws, flat head screws for standard junction box covers, etc.).
02 The security integrator shall provide Torx® tamper resistant screws for:
a. Junction boxes located above doors
b. Junction boxes located below ceiling height and/or within reach of hatch ladders
c. Security device cover plates
d. Surface mounted door position switches and armored cable

3.2 ENCLOSURE INSTALLATION

A. Enclosures shall be lockable with a tamper switch and installed in a manner to be accessible with clearance to fully open enclosure door.

B. All security panels shall be wired through a dedicated power supply with battery backup.
01 Power to the data gathering panels is to be hardwired utilizing EMT or rigid conduit in accordance with the Electrical specifications.
02 A circuit from the Fire Alarm panel must be installed to each lock power distribution panel.

C. Enclosures shall be installed on designated wall fields in a neat and compact manner to allow for future growth.

D. Enclosures shall be sized to allow for 20% growth in each panel.

E. All panels and boards shall be installed in enclosure(s) suitable to their environment and have sufficient size and orientation to include all system components.

F. Each panel shall be labeled accordance with Owner standards.
01 The label for each panel shall be posted on the exterior of the panel door.
a. Each panel shall have a list of devices connected to it located on the inside cover.
b. A detailed device layout drawing will be located on the inside of the panel door in an appropriate sleeve and keeper.

3.3 FURTHER REQUIREMENTS

A. Refer to provisions of Section 28 02 00

B. Furnish and coordinate installation of all special device back boxes and AC field devices as shown on the security drawings and as specified in this section.

C. The exact installation locations of all equipment shall be coordinated and verified with the Contractor prior to installation.
01 Subcontractor shall notify the Contractor if any location appears to be unsuitable.

D. Provide low voltage power supplies for electric locking devices and AC devices and components as shown on the security drawings and specified in this Section.

E. Coordinate with the Telecommunications Subcontractor for data network connections, IP address requirements, and telephone circuits as required.

F. Prepare all systems for user operation.
   01 The security system must be complete and ready to operate prior to Owner final acceptance of the system.

G. Coordinate with the Owner for all system programming requirements.

H. Perform database programming as required to support the card reader, alarm point, surveillance system integration, and control panel configuration as required.

END OF SECTION

SECTION 28 46 00

FIRE ALARM SYSTEM WITH ELECTRONIC AUDIO AND VISUAL DEVICES

PART 1 - GENERAL

1.1 SCOPE

A. The contractor shall provide a complete microprocessor based 24VDC, electrically supervised, analog intelligent fire alarm system as specified. The system shall include, but not be limited to, all control equipment, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.

B. All equipment, materials, accessories, devices, etc. covered by the specifications shall be new and shall be U.L. listed for their intended use.

C. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.

D. The system shall be wired as a Class B supervised system for all circuits.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces; Current Edition, Including All Revisions.

H. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.

I. UL 228 - Safety Door Closers-Holders, with or without Integral Smoke Detectors; 2008.

J. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

K. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.

L. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

M. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.

N. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

O. UL 1638 - Standard for Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

P. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

Q. UL 2034 - Standard for Single and Multiple Station Carbon Monoxide Alarms; Current Edition, Including All Revisions.

R. UL 2075 - Standard for Gas and Vapor Detectors and Sensors; Current Edition, Including All Revisions.

1.3 INSTALLING CONTRACTOR'S RESPONSIBILITY

A. The installing fire alarm contractor is responsible for the design of a code compliant system, which meets the intent of all State and Local Authority Having Jurisdiction Codes and their adopted amendments along all permitting of such plans and associated permit fees. Reference and coordinate with all contract specifications and plans.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:
   01 Notifier Fire Systems Inspire Series
   02 Edwards System Technology (EST 4)

B. Alternate Manufacturers
   01 Equipment from other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the architect/engineer for five (5) days prior to bid.

1.5 GENERAL REQUIREMENTS

A. Contractor Qualifications:
   01 The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
   02 The equipment supplier and installing contractor shall be licensed by the State Fire Marshal to sell, install, and service fire alarm systems as required by Article 5.43-2 of the State Insurance Code.

03 The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation superintendents who are licensed by the State Fire Marshal's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the State insurance code.

04 The installing contractor or equipment supplier shall have on staff a minimum of one (1) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.

05 The installing contractor shall provide 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.

06 The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.6 SUBMITTALS

A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:

01 Control panel configuration including wiring and interconnection schematics.

02 Complete point to point wiring diagram showing terminal connections to all system devices.

03 Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.

04 Complete floor plan drawings in a PDF format shall locate all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type.

05 Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.

06 Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.

07 Complete Bill of Material for reference.

08 Programming matrix defining all input/output functions and zoning.

09 Power supply and battery calculations.

10 A written certification from the manufacturer stating that the fire alarm system contractor is authorized to sell, service and install the submitted equipment.

B. Submittal shall include documentation confirming all qualifications have been met. Submittals without qualification documentation shall be returned "Revise and Resubmit".

C. All submittal data shall include the contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.

1.7 COORDINATION

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of: elevator, electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 – PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

A. Alarm Detection

01 When a fire alarm condition is detected by any of the system alarm initiating devices, the following functions shall occur:
   a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledgment or silencing the alarm condition shall silence the alarm signals and cause flashing alarm LED's to illuminate steady.
   b. A multi-character back-lit LCD display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.
   c. Any remote or local annunciator LED's associated with the alarm zone shall be illuminated as herein specified.
   d. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
   e. Activate all audible and visual alarm notification devices throughout the facility.
   f. De-activate HVAC systems over 2,000 CFM.
   g. Display system status changes on the remote annunciators.
   h. Release all smoke doors, fire doors, fire coiling doors, fire smoke dampers and fire shutters.
   i. Activate the smoke control system for the atrium.
   j. Recall elevators to ground floor as specified herein, or to the alternate floor if the alarm condition originates on the ground floor
   k. Unlock all electrically operated doors

B. System Trouble Detection
   01 When a trouble condition is detected by the CPU, one of the system initiating, alarm or SLC circuits, the following functions shall immediately occur:
      a. The system trouble LED on the CPU module shall flash and the internal audible trouble device shall sound. Acknowledgment of the trouble condition shall silence the audible trouble device and cause all trouble LED's to illuminate steady.
      b. The multi-character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.
      c. The system common trouble indicator on associated remote annunciators shall be illuminated as specified herein.

C. Auxiliary Control
   01 All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).
   02 Activation of duct smoke detectors associated fans shall shutdown their respective units immediately in addition to identifying the condition as herein specified. Duct detectors shall be programmed as a supervisory condition per NFPA 72.

D. System Supervisory Detection
   01 When a supervisory condition is detected by the fire alarm control panel, the following functions shall occur:
      a. The fire alarm control panel supervisory indicator shall flash and the internal audible device shall sound Acknowledgment of the supervisory condition shall silence the audible device and cause the supervisory indicator to illuminate steady
      b. The multi-character liquid crystal display shall display all applicable information associated with the respective supervisory condition.

c. Display the system status change on the remote annunciators

E. Remote Off-site Monitoring

01 The remote off-site monitoring system shall transmit point specific alarm, trouble and supervisory signals to an Approved Central Supervising Station (Central Station connection, phone lines or cellular connectivity service provided by Owner).

F. Fire Drill Control

01 Provide a fire drill switch located on the Fire Alarm Control Panel. When activated, this switch will activate all horns and visual devices (strobes) for a fire drill. It shall not release fire shutter, shut down air handling equipment or recall elevators. If a fire alarm condition is detected, the system shall operate as defined in part A - "Alarm Detection" of this section.

2.2 ZONING

A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the Architect/Engineer.

2.3 FIRE ALARM CONTROL PANEL

A. The fire alarm control panel shall be provided with adequate number of SLC points to serve the building plus 50% spare. The control panel shall utilize DISTRIBUTED solid state MICROPROCESSORS. The microprocessor based CPU shall be completely FIELD PROGRAMMABLE. CPU module shall provide for programmable non-volatile EEPROM memory. All circuitry shall be U.L. listed for power-limited application. System shall be sized to accommodate the capacity of the system specified and shown on the drawings. System shall be capable of being networked for future expansion.

B. Portable Buildings

01 Provide a minimum of (50) fifty initiating points for future portable buildings. Provide (2) dedicated NAC circuits pulled to the exit point above the ceiling. Refer to floor plan for location.

C. Central Processing Unit Module (CPU)

01 The CPU shall contain and execute all custom time control functions or control- by-event programs for specified events including 'Holiday' exceptions. Time control event/programs shall be automatically overridden by priority fire alarm events. All programs shall be held in non-volatile programmable memory, and shall not be lost if both system primary and secondary power failure occurs.

02 System CPU shall also provide for non-alarm points for non-fire, low priority building functions. The CPU shall provide capability of multi-stage signaling, tornado warning, emergency radio communication enhancement system, positive alarm sequencing as well as remote control system operation.

D. Display Interface Assembly (DIA)

01 The DIA shall provide a multi-character backlit, supertwist Liquid Crystal Display (LCD). It shall provide Light-Emitting Diodes (LED's) for AC POWER; SYSTEM ALARM; SYSTEM TROUBLE; SUPERVISORY; CPU FAIL; and ALARM SILENCED.

02 The display shall provide power to a 25-key membrane keypad with control capability to command all system functions, status readouts, manual control action, and entry of any alphanumeric or numeric information. The keypad shall include means to enter multiple five digit passwords to prevent unauthorized manual control programming.

E. Control Switches
01 Acknowledge/step Switch
02 Signal Silence Switch
03 System Reset Switch
04 System Test Switch
05 Lamp Test

F. System Outputs
01 The system shall provide the following outputs:
a. One port for lap top and/or modem
b. One port for supervised remote LCD annunciators (RS-485)

G. Loop Interface (SLC)
01 The CPU shall communicate and provide power to all devices on its loop over a single pair of wires. The CPU shall receive digital/ANALOG information from all "intelligent" detectors and shall process this information to determine normal, alarm, trouble, and sensitivity conditions. The analog information may be used for automatic test and determination of maintenance requirements, and be U.L. listed for such use. The CPU module shall individually monitor all "intelligent" detectors for sensitivity variation initiating a trouble condition should detector sensitivity "drift" become excessive. The system control unit shall have the capability to remotely read each detector's sensitivity in % obscuration, and if need be, electronically adjust the detector sensitivity as required for existing conditions within U.L. recommended limits. In addition, the system shall incorporate a "day/night" sensitivity feature. The system shall provide capability to program each individual detector for multiple 'pre-alarm' conditions. Each 'pre-alarm' level shall be field programmable as a function of the programmed alarm level. The system shall allow designated control-by-event actions to occur as may be required prior to any sensor reaching the designated alarm point.

H. Non-Lock Walk Test
01 The system shall include a special non-lock "walk test" mode. The walk test mode shall incorporate a time-out feature to return system to normal. Test results shall be capable of being generated and displayed on the LCD annunciator.

I. Automatic Detector Test
01 The system shall include a special automatic detector test feature, which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. An automatic detector test shall occur automatically a minimum of every two hour period or be initiated manually from the FACP as desired. Automatic detector test sequencing shall be terminated upon receipt of a true alarm condition.

J. Special System Reports

01 The system shall have the ability to generate and print, upon command, system and point status reports. Selection of 'system' read status provides the operator with global system programming information as well as providing the operator with all individual point programming data. The system shall also provide the capability to print out a detailed 'history' report from system history file upon command.

K. Field Programming

01 The system shall be 100% field programmable without the need for external computers or, PROM programmers, and shall NOT require replacement of memory IC's. All programs shall be stored in non-volatile EEPROM memory. Programming shall be accomplished only after entering an appropriate and pre-selected five digit password security code. System programming mode shall NOT require the system to be taken off-line nor prohibit the system from performing its normal operations and routines. The system shall be capable of revising/changing programmed functions or system expansion at any time subsequent to initialization as described herein without factory modifications or factory programming. Field programming via the use of external computers may be considered provided programming can be accomplished on-site and the owner is permanently furnished with the required programming apparatus and software as part of this contract.

L. Event History

01 The main fire alarm panel shall have the resident ability to store a minimum of 600 system events in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via five digit password security code.

M. Power Supply

01 The power supply shall provide all control panel and peripheral power needs with filtered power as well as rectified 24VDC power for external audio-visual devices. All power supplies shall be designated to meet UL and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits.

02 Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, A.C. power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.

03 Batteries shall have 24 hours of standby capacity and 5 minutes of alarm capacity. Battery charger shall recharge batteries from full discharge to full charge over a 24-hour period. Switching from normal power to battery power and back shall occur automatically.

2.4 FIELD DEVICES

A. Multi Criteria Smoke Detector (Smoke and Heat)

01 Provide intelligent multi detector. The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in micro processor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

02 The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen, etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes)

03 The intelligent multi criteria detection devices shall included the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chamber and comparing them to a database of actual fire and deceptive phenomena.

04 The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

B. Air Sampling Smoke Detector

01 Provide VESDA air sampling addressable smoke detection system to provide proper coverage based on in areas with ceiling higher than 18 feet. Fire alarm contractor shall include pipe layout as well as pipe calculations in the fire alarm system shop drawings.

02 The air sampling smoke detection system shall integrate into the fire alarm system as an addressable device residing on the signaling line circuit. Each VESDA detector shall be interfaced to the fire alarm system via four separate points (one trouble and three distinct alarm points). Each VESDA detector shall be provided with its own battery backup system as required by NFPA 72. VESDA smoke detector shall be located in a non-public area such as a mechanical, telephone, IDF, or storage room in the vicinity of the atrium. All VESDA air sampling shall be supported every five feet.

C. Linear Beam Detector

01 Linear Beam Detector shall be a single unit containing the transmitter and receiver in the same enclosure. This detector can operate over a range from 17ft to 280ft (5m to 85m). The detector shall have three sensitivity settings, shall have high immunity to extraneous light, and have automatic and comprehensive test. Unit shall be monitored and interconnected to the main fire alarm control panel.

D. Intelligent Duct Detector

01 Provide duct mounted “intelligent” photoelectric smoke detectors shall be provided per applicable codes. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type “intelligent” smoke sensors. The unit shall be capable of interchanging/accepting either photo-electronic or ionization type sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the use of zone modules.

02 The unit shall consist of a clear molded plastic enclosure with integral conduit knockouts. The unit shall be provided with clear faceplate cover to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit’s sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination. Detectors shall be installed per NFPA 90A, and be listed with the fire alarm control panel. A remote LED shall be located on the corridor ceiling adjacent to the respective detector where detectors are not plainly visible or concealed from view.

E. Intelligent Thermal Detectors

01 Provide analog, fixed temperature thermal detectors. The detectors shall use dual electronic thermostats to measure temperature levels in the chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.

02 The detectors shall provide dual alarm and power/status LED's. Status LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also provided in the base to connect an external remote alarm LED.

03 The detectors shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

F. Conventional Weatherproof Thermal Detector

01 Provide heat detection devices when located in harsh and/or moist environments, such as showers and similar areas, which are subject to high humidity, the following device shall be provided. Weatherproof Heat Detector 135°F Rate Compensated shall be provided. The detector shall mount in a weatherproof 4" electrical box with 1/2" NPT threaded hub. This detector shall be connected to an addressable monitor module.

G. Addressable Manual Pull Stations

01 Provide Manual stations..

a. The manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel.

b. All manual pull stations shall be considered of durable molded polycarbonate material and shall be RED in color with raised white lettering. Stations be the dual action type.

c. All manual pull stations shall be provided with an STI-1100 series clear plastic cover with integral horn.

H. Monitor Module

01 Provide addressable monitor modules where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.

I. Control Module

01 Provide control and relay modules where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B - field selected. The control module may be optionally wired as dry contact (form C) relay.

02 The control module shall be addressable. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steady when the device is actuated via the fire alarm control panel.

J. Electronic Audio Visual Devices

01 Audible/Visual alarm devices shall be electronic horn/strobe units. Devices shall be wall or ceiling mounted. Devices shall be provided with the ability to provide multiple candela settings. Units shall operate at 24VDC and be polarized supervised. Each unit shall provide a choice of three difference audible tones capable of being field selected. Preferred alarm signal shall be a temporal tone producing a sound pressure level of 84 dBA. The visual device shall use Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit and meet the requirements of ADA and local codes. Strobe unit shall automatically flash upon operation of the horn. Horn/strobe unit shall be provided in textured white finish and be flush mounted. All visual devices shall be synchronized.

K. Electronic Alarm Horn

01 Provide solid state electronic alarm devices where indicated on the contract drawings. Units shall operate at 24 VDC and be polarized supervised. Each unit shall provide a choice of three different audible tones capable of being field selected. Preferred alarm signal shall be a temporal tone producing a sound pressure level of 84 dBA.

02 Units shall be flush mounted and molded of high-impact white plastic.

L. Exterior Audio Visual Devices

01 All audio visual devices located outside or labeled weatherproof shall be weatherproof.

02 All devices shall be provided with a weather proof type back box.

M. High Intensity Visual Signals

01 Provide visual signal device as may be required by the Americans with Disabilities Act (Public Law 101-336) and local codes. High intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Alarm devices shall be ceiling mounted. Signals shall operate in unison with audible alarm appliances. All visual devices shall be synchronized. Units shall be flush mounted and shall be provided in textured white.

N. Sprinkler Waterflow Switch

01 Sprinkler water flow switches shall be installed where indicated on the drawings. Each unit shall contain one set of SPDT alarm contacts. Water flow switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor.

O. Sprinkler Valve Supervisory Switch

01 Sprinkler valve supervisory switches shall be installed on each valve as indicated on the drawings. Each unit shall contain on set of SPDT contacts. Sprinkler valve supervisory switches shall be provided, installed, and adjusted by the fire protection contractor, and connected by the fire alarm contractor.

P. Auxiliary Air Handling Unit (AHU) Relays

01 Relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as (fail safe) so that if the cable is broken, disconnected etc., the AHU will automatically shutdown.

Q. HVLS Fan Relays

01 Provide relays for high-volume low-speed (HVLS) fans to shut down immediately upon receiving a sprinkler waterflow signal per NFPA 72. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as activated LED indicator. All interface relays shall be connected to a supervised notification appliance circuit.

R. Field Charging Power Supplies

01 Provide power supplies with battery backup as required. Provide 120 volts dedicated circuit to each power supply.

S. Remote LCD Alpha-Numeric Annunciators

01 Provide remote LCD alpha-numeric annunciator to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 and RS232 serial output terminal from main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The luminary source shall extinguish during normal/standby model to conserve power. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote LCD annunciator shall include:

a. Integral time-date clock
b. Time-date select clock
c. Time-date/contrast adjust
d. Display/step switch
e. System reset
f. System silence
g. System acknowledge
h. Integral trouble buzzer

02 Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be semi flush mounted where shown.

T. Protective Covers

01 Provide protective covers on all wall mounted fire alarm devices located in student restrooms, corridors and in the cafeteria. These protective covers shall be manufactured by Safety Technology International, Inc. (STI). These covers shall be provided on all devices including but not limited to smoke detectors, heat detectors, audible and visual devices, pull stations, etc. The mounting of a device shall be reinforced to enable the protective covers to protect the fire alarm devices.

U. Multi Criteria Fire/Carbon Monoxide (CO) Detector (FCO-951) for sleeping rooms

01 Multi criteria acclimating detector shall be provided where shown on the drawings. The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric, flame, thermal and CO technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings.

02 The detector design shall allow for a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

03 The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

04 The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the flame, thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

05 The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base with integral sounder.

06 Provide integral low frequency sounder base for smoke detection and 4-code temporal sound for CO detection.

V. Smoke Alarms for Dwelling Units

01 The combination photoelectric smoke and carbon monoxide alarm shall be a Gentex Model GN-503/GN-503F/GN-503FF or approved equal which shall provide at least the following features and functions:

a. The smoke alarm portion of device shall utilize an infrared LED sensing circuit which pulses in 4 to 5 second intervals when subjected to smoke. After 2 consecutive pulses in smoke, the alarm shall activate.

b. The CO alarm shall utilize an electrochemical sensing element with a minimum 5-year life.

c. The carbon monoxide alarm portion of device is adjusted not to detect CO levels below 30 PPM and will not alarm when exposed to constant levels of 30 PPM for 30 days. Per UL 2034 requirements, the device will alarm at the following levels: 70 PPM CO between 1 to 4 hours, but not less than 1 hour. 150 PPM CO between 10 to 50 minutes. 400 PPM between 4 to 15 minutes.

d. The GN-503 Series device shall have a 9VDC alkaline battery as a back-up in the event building power is lost.

e. The alarm shall provide an indicator when the battery is low in power, high impedance or is missing.

f. The CO alarm will provide an audible indicator of 3 quick chirps every 30 seconds at end of life of CO sensor.

g. The alarm shall include a solid state red color LED that will indicate presence of CO at the unit.

h. The audible alarm shall include a solid state piezo alarm rated at 85dBA at 10ft.

i. A visual LED monitor (condition indicator) shall slow pulse in normal operation and rapid pulse in alarm (red color)

j. An easily accessible test button shall be provided. Push down on button for 5 seconds causing smoke/CO alarm to activate.

k. The device shall have tandem interconnect capability of up to 12 smoke/CO alarms.

l. The GN-503FF alarm shall have the capability to tandem interconnect with all Gentex tandem capable smoke alarms, CO alarms or combination smoke/CO alarms.

m. The manufacturer shall provide models with the optional feature of auxiliary Form A/Form C relay contacts for initiating remote functions and annunciation and a relay option that is capable of activation by tandem interconnect wire.

n. The combination smoke/CO alarm shall be non-latching (self-restoring).

02 Power and Interconnection Requirements

a. Provide 120 VAC primary power from building wiring served from a commercial source.

b. Provide interconnecting tandem wiring between smoke/CO alarms so that the activation of one alarm will activate all of the alarms in the individual unit.

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. The contractor shall provide drawings for Owner, Engineer and Fire Marshal's approval.

B. Drawings shall be prepared by a state licensed alarm planning superintendent.

C. Drawings shall comply with all local, state and federal code. These include but are not limited to NEC, UL, NFPA, etc.

D. Locate the fire alarm control panel in main telecommunications / MDF room unless otherwise directed by the owner.

E. Locate a remote annunciator in the main lobby area unless otherwise directed by the owner.

F. Provide additional items required above minimum codes include the following:

01 Manual pull stations shall be located not more than 5 feet from the entrance to each exit. Additional manual stations shall be located so that the travel distance to the nearest manual station does not exceed 200 feet. Provide Stopper II covers on all manual pull stations

02 Manual pull station heights shall be a minimum of 42" and a maximum of 48" measured vertically, from the finished floor level to the activating handle or lever.

03 Smoke Detectors – Paths of egress, electrical rooms, mechanical rooms, MDF, IDF, elevator lobby, storage rooms, top of stairs, elevator machine room, top of elevator shaft, above each fire alarm panel and remote power supplies terminal cabinets. Smoke detectors shall also be provided in each room/area that can be occupied by kindergarten and pre-kindergarten children, which shall include cafeteria, gymnasiums, daycares, libraries, classrooms and similar areas. Provide a VESDA smoke detection system in paths of egress where ceiling heights exceed 18 feet.

04 Duct type smoke detectors – all air handling units over 2,000 CFM in duct work or return air paths.

05 Heat Detectors – Shops, kitchens, coffee bars, central plants, boiler room, garages, truck bays and other non conditioned areas when detection is required..

06 Flow switches – Sprinkler riser.

07 Horns - throughout the building.

08 Strobes – throughout the building.

09 Remote Power supplies: Locate in mechanical rooms, electrical rooms, MDF or other areas approved by Owner.

10 Smoke Detectors with low frequency sounder bases inside and outside all sleeping rooms. Do not locate over bed.

11 Monitor Fire Pump.

12 System Carbon Monoxide Detectors - Provide one in each sleeping room, kitchen, and the first room of each mechanical system where gas furnaces are serving spaces. Combination CO and smoke detector may be utilized in sleeping rooms. Provide CO detection in locations where gas water heaters are provided. Locate near the door; do not locate over the bed.

13 Tamper Switches- Sprinkler riser and vaults located on the site.

3.2 INSTALLATION

A. Wiring

01 All wiring shall be in accordance with NFPA 72 and NFPA 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

02 All wire shall be plenum rated, U.L. Listed, limited energy (300 volt) FPLP or MPP wire and shall be run open in return air ceiling plenums. The wire shall comply with NFPA 262 for such applications, shall be of the low smoke producing fluorocarbon type and shall comply with NEC Article 760 if so approved by the local authority having jurisdiction. Provide conduit in all inaccessible locations, inside concealed wall, all mechanical/electrical rooms, or other areas where wiring might be exposed and subject to damage.

03 Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.

04 All wiring for SLC signaling circuits shall be of the twisted low capacitance type to guard against outside RF and EMF interference and induced noise.

05 All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA.

06 Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Devices shall be appropriately marked designating it as the terminating device on the respective circuit.

07 No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.

08 All insulation on conductors shall be RED with traces to identify circuits.

B. Open Wiring

01 Systems utilizing open wiring techniques with low smoke plenum cable.

02 Support wire clear of knock out panels access panels and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot on centers. Wire routing shall be parallel and perpendicular to building lines. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.

03 Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacturer.

04 Provide a junction box to make up all joints and splices.

05 Provide cable supports in all vertical raceways in accordance with Article 300-19 of NFPA 70.

C. Conduit/Raceway

01 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.

02 Conduit and raceway system shall be installed as specified in division 26 specifications and per National Electrical Code.

03 Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

04 All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.

05 Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Minimum Wire Sizes Shall Be As Follows:

01 Signaling Line Circuit: 18 AWG

02 Notification Appliance Circuit: 14 AWG

03 Relay Control Circuits: 18 AWG

E. 120 VAC Power wiring

01 Contractor shall provide all required dedicated 20 amp, 120 VAC power circuits for the fire alarm system including but not limited to the main fire alarm panel, remote amplifier panels, and remote strobe light power supplies. Connect to emergency power when available in the building.

F. Sprinkler Valves

01 Contractor shall connect all tamper switches and post indicator valves to the supervisory circuit. Connect all water flow switches to the alarm circuit. Coordinate exact locations of water vaults valves and flow switches with sprinkler contractor.

3.3 NOTIFICATION APPLIANCE CIRCUITS SYNCHRONIZATION

A. All visual and audible devices shall be synchronized per the current state adopted version of NFPA 72. Provide all components required.

3.4 SMOKE AND COMBINATION FIRE SMOKE DAMPERS

A. Provide duct type smoke detectors in ductwork downstream of each smoke damper and fire smoke damper. Locate within 5 feet on the damper. Provide a remote smoke detector reset device. Provide access panel when not located above an accessible ceiling. Interlock with HVAC unit serving the ductwork to shut down.

3.5 MISCELLANEOUS SYSTEMS

A. Monitor all fire suppression systems, carbon monoxide system panels and refrigerant system control panels.

3.6 TEST AND REPORTS

A. A state licensed factory trained technical representative of the manufacturer shall perform the final control panel connections and supervise testing of the system and it shall be subject to the approval of the responsible engineer and owner. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.

B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision to insure proper wiring installation. Any items found not properly installed or non-functioning shall be replaced or repaired and re-tested. All testing shall be supervised by a licensed fire alarm superintendent.

C. The installing contractor shall provide a complete written report on the functional test of the entire system. The test and report shall verify the function of each device in the system, operation of all auxiliary control functions, and the proper operation of the main fire alarm control panel. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

D. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction.

3.7 SPARE PARTS AND ATTIC STOCK

A. Provide 5% spare field devices including labor to install them. Devices not used shall be given to the Owner at completion of the job.

B. The fire alarm contractor shall include in his bid the cost to provide and install the additional spare parts and attic stock and associated cabling as indicated on the schedule on the contract drawings. All devices on this schedule not used during construction shall be turned over to the owner at the time of job completion.

3.8 WARRANTY

A. The fire alarm system shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.

3.9 GRAPHIC FLOOR PLANS

A. Provide 1/16” = 1’-0” floor plan showing all devices and zoning. Zoning shall correspond to the zone on the fire alarm control panel. The floor plans shall be framed with a glass cover and located by the fire alarm control panel. This graphic floor plan shall use the actual room numbers based on the architectural graphics package. Verify specific requirements with Owner. Provide a sample for approval.

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Operations required for the excavation of materials on site.

1. Operations required for the excavation of borrow material from approved sources.
2. Compaction of natural subgrades.
3. Placement and compaction of embankments to grade.
4. Finish grading.
5. Disposal of excess or unsuitable materials.
6. Other required operations.
7. Earthwork must conform with dimensions and typical sections shown, and within lines and grades established on the Drawings.

B. The Contractor shall inform and satisfy himself as to character, quantity and distribution of material to be excavated.

1.2 EXISTING UTILITIES

A. The plans show the approximate location of all known underground utility lines and structures. Where pipes, ducts and other structures are encountered in the excavation but are not shown on the plans, immediately notify the Owner's Representative.

1.3 CLASSIFICATIONS

A. Top Soil: Top 6 inches of natural surface soil possessing the characteristics of representative soils on the site that produce growths of grass or other vegetation. Topsoil includes grasses and other vegetation.

B. Subgrade: Consists of that portion of the surface on which a compacted embankment or pavement is constructed.

C. Compacted Embankment: Earth fill placed and compacted between subgrade and underside of pavement and fill areas adjacent to paving.

D. Borrow: Material taken from approved sources to make up any deficit of excavated material. The borrow shall have a measured plasticity index of between 7 and 20, and shall be free of organic matter and excess silt.

E. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.

F. Stripping of Ground Surface: All vegetation, all decayed vegetable matter, rubbish and other unsuitable material within the areas to be graded not removed by clearing shall be stripped or otherwise removed to ground level before grading or other earthwork is started. In no case will such material be allowed to remain in or on the areas to be graded.

G. Excavation: After all necessary stripping has been done, excavation of every description and of whatever substances encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings.

H. Compaction: Compaction of soil materials shall be measured as a percentage of Standard Proctor density as determined by the ASTM D698 procedure.

PART 2 P R O D U C T S

2.1 EQUIPMENT

A. Furnish, operate and maintain such equipment as is necessary to produce uniform layers, section and smoothness of grade for compaction and drainage.

B. Tamping Rollers:

1. Use tamping rollers with one or more cylindrical drums. Each cylinder must be at least 48 inches long and 40 inches in diameter.
2. The minimum weight per linear foot of drum length must be 1500 pounds weighted and 1000 pounds empty.
3. For tamping rollers with multiple cylinders, each cylinder must rotate independently and the cylinders must be pivoted on the main frame so that the units can adapt to irregularities in the ground surface.
4. Provide approximately 2.7 tamping feet per square foot of drum surface on each cylinder. Stagger the feet uniformly over the cylinder surface. Each foot should have a face area between 5 and 7 square inches and a clear projection from the cylinder surface of 7 to 9 inches. Equip each unit with a device for cleaning the feet as the cylinders rotate.
5. Use a crawler tractor with sufficient power to pull the tamping roller at a speed of approximately 3.0 miles per hour.

C. Rubber Tire Rollers:

1. Use rubber tire rollers having two axles and not less than a total of nine wheels with pneumatic tires.
2. Mount the wheels so that the rear tires will not follow in the tracks of the forward tires and so the unit will give uniform compaction over the entire width of coverage.
3. Mount the axles in a rigid frame with a loading platform or body suitable for being ballasted to a specified gross weight between 10 and 50 tons loading. The Owner's Representative will specify the tire inflation and gross weight.
4. If the roller is not self propelled, the towing equipment must also have pneumatic tires.

D. Use tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.

E. Scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment and other equipment must be suitable for construction of fills.

2.2 EARTH FILL

A. Obtain embankment fill from required excavation or, if excavated material is not sufficient, from Borrow areas approved by the Owner's Representative.

B. Use the best material available from excavation or borrow. Suitability of fill material is subject to the approval of the Owner's Representative.

C. Fill material must be free of excessive silts. Do not use soil containing brush, roots, sod or similar perishable material.

D. Embankment material must have a plasticity index between 7 and 20 inclusive.

PART 3 E X E C U T I O N

3.1 REMOVAL OF TOPSOIL

A. Remove topsoil within the limits of the construction areas as shown on the Drawings.

B. Stockpile the topsoil for future distribution. Protect stockpiled topsoil from other excavated materials.

3.2 EXCAVATION

A. As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction of embankments or pavement. Remove materials within the indicated limits and dispose of as directed.

B. Maintain grades during excavation for complete drainage. When required, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the Work.

C. If at time of excavation it is not possible to place material in the proper section of permanent construction, stockpile the material in approved areas for later use.

D. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in top 6 inches of subgrade.

E. Uniformly dress cut and fill slopes to slope, cross section and alignment, as shown.

3.3 SUBGRADE UNDER PAVEMENTS

A. After excavation is made to subgrade lines under proposed pavements, remove and replace soft or undesirable material with select material as specified for embankments. Stabilize and compact the subgrade as stated in the sections on stabilization of pavement subgrade.

3.4 TREATMENT OF NATURAL SUBGRADE UNDER EMBANKMENTS

A. After excavation is made to lines under proposed embankments, remove soft or undesirable material to a depth determined by the Owner's Representative. Break down sides or holes or depressions to flatten the slopes.

B. Fill each depression with the appropriate soil for the materials to be placed on the subgrade. Place the fill in layers moistened and compacted as specified in this section.

C. After depressions have been filled and immediately before placement of compacted fill in a section of the embankment, thoroughly loosen the foundation material to a depth of 6 inches. Remove roots and debris turned up while loosening the soil.

D. Compact the surface of the embankment subgrade as specified in the following paragraphs.

E. Take care to prepare the embankment so that planes of seepage or weakness are not induced. Should the Owner's Representative suspect such a deficiency, the material must be thoroughly broken and recompacted before proceeding with construction.

3.5 PLACING EMBANKMENT FILL

A. Do not place fill on any part of the embankment subgrade until the subgrade preparation has been inspected by the Owner's Representative.

B. During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the embankment material.

C. After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction must not exceed 8 inches unless otherwise directed. As soon as possible after placement begins, crown the surface to drain freely and maintain such conditions throughout construction.

D. If the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.

E. Stabilize and compact the top 6 inches of embankment fills under pavement sections as specified in the section on stabilization of pavement subgrade.

3.6 MOISTURE CONTROL

A. Developing the maximum density obtainable with the natural moisture of the embankment material is preferred. However, the moisture content must be 1 to 3 percentage points wet of optimum, as determined by ASTM Test Method D698 procedure.

B. If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by discing or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other approved method.

3.7 COMPACTION

A. Compact each layer of embankment with suitable rollers as necessary to secure at least 95% of the standard Proctor density, within the specified range of the moisture content, according to ASTM Test Method D698 procedure.

3.8 DISTRIBUTION OF TOPSOIL

A. Preparation:

1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade. Use a chisel plow with the chisels set 10 inches apart.
2. Shape all areas designated for grading, including cut and fill areas, to receive a minimum of 6 inches of topsoil.
3. In areas that require only blading and dressing, the adequacy of existing topsoil will be determined by the Owner's Representative.

B. Placement:

1. Do not haul or place wet topsoil. Also prohibited is placement of topsoil on a subgrade that is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading or proposed planting.
2. Distribute topsoil uniformly and spread evenly to an average thickness of 6 inches. Do no compact topsoil. Correct irregularities in the surface to prevent formation of depressions where water could stand.
3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth and suitable for lawn planting.

C. Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement. Replace topsoil.

3.9 MATERIAL DISPOSAL

A. Remove excess excavated material and excess topsoil from the area before substantial completion. Stockpile materials separately in designated areas. Excess soil, topsoil and strippings shall become property of the Contractor and shall be removed from the site.

B. Dispose of waste material without causing expense or damage to the Owner.

END OF SECTION 31 00 00

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SECTION 31 06 20.15

CEMENT STABILIZED SAND

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Cement stabilized sand.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring cement stabilized sand.
2. Refer to Paragraph 3.04 for material credit.
3. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).

B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

C. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

D. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

E. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

G. ASTM C 150 - Specification for Portland Cement.

H. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.

I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.

J. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.

K. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

L. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

M. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.

N. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.03, Materials Qualifications.

1.5 DESIGN REQUIREMENTS

A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.

1. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
2. Determine minimum cement content from production data and statistical history. Provide no less than 1.5 sacks of cement per ton of dry sand.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Cement: Type I Portland cement conforming to ASTM C 150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Division 2 and the following requirements:

1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
2. Deleterious materials:
   a. Clay lumps, ASTM C 142 - less than 0.5 percent.
   b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
   c. Organic impurities, ASTM C 40, color no darker than standard color.
3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.

C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

A. Add required amount of water and mix thoroughly in pugmill-type mixer.

B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.3 MATERIAL QUALIFICATION

A. Determine target cement content of material as follows:

1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
2. Complete molding of samples within 4 hours after addition of water.

3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
4. Perform cement content tests on each sample.
5. Perform moisture content tests on each sample.
6. Plot average 48-hour strength vs. cement content.
7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).

B. Test raw sand for following properties at point of entry into pug-mill:

1. Gradation
2. Plasticity index
3. Organic impurities
4. Clay lumps and friable particles
5. Lightweight pieces
6. Moisture content
7. Classification

C. Present data obtained in format similar to that provided in sample data form attached to this Section.

D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula: f'c% 1/2 standard deviation

PART 3 E X E C U T I O N

3.1 PLACING

A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is +3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.

B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Division 1.

B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purposes.

C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately the same time material is being used, but no later than 4 hours after water is added to mix.

D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.

F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.

H. Reporting: Test reports shall contain, as a minimum, the following information:

1. Supplier and plant number
2. Time material was batched
3. Time material was sampled
4. Test age (exact hours)
5. Average 48-hour strength
6. Average 7-day strength
7. Specification section number
8. Indication of compliance / non-compliance
9. Mixture identification 3
10. Truck and ticket numbers
11. The time of molding
12. Moisture content at time of molding
13. Required strength
14. Test method designations
15. Compressive strength data as required by ASTM D 1633
16. Supplier mixture identification
17. Specimen diameter and height, in.
18. Specimen cross-sectional area, sq. in.

3.3 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:

1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor’s expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.

D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

E. Testing laboratory shall notify Contractor, Owner's Representative, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less that 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.4 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula: Credit per Cubic Yard = $30.00 x 2 (100 psi - Actual psi) 100

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to Owner.

END OF SECTION 31 06 20.15

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SECTION 31 06 20.17

UTILITY BACKFILL MATERIALS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Material Classifications.

B. Utility Backfill Materials:

1. Concrete sand
2. Gem sand
3. Pea gravel
4. Crushed stone
5. Crushed concrete
6. Bank run sand
7. Select backfill
8. Random backfill

C. Material Handling and Quality Control Requirements.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for backfill material. Include payment in unit price for applicable utility installation.
2. Payment for backfill material, when included as separate pay item or when directed by Owner's Representative, is on cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to Drawings, or as directed by Owner's Representative.
3. Payment for backfill of authorized over-excavation is in accordance with Division 31.
4. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

A. Unsuitable Material:

1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
4. Materials contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material:

1. Materials meeting specification requirements.
2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.

E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.

F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.

H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

J. Refer to Division 33 for other definitions regarding utility installation by trench construction.

1.4 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregate.

B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.

E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.

H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

K. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.

L. TxDOT Tex-460-A - Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.5 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.

D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.

E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

1.6 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.

B. Verification tests of backfill materials may be performed by Owner in accordance with Division 1.

PART 2 P R O D U C T S

2.1 MATERIAL CLASSIFICATIONS

A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
    a. Plasticity index: non-plastic.
    b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
    a. Plasticity index: non-plastic to 4.
    b. Gradations:
        1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
        2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
        3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.

3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
    a. Plasticity index: greater than 7.
    b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.

4. Class IVA: Lean clays (CL).
    a. Plasticity Indexes:
        1) Plasticity index: greater than 7, and above A line.
        2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
    b. Liquid limit: less than 50.
    c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
    d. Inorganic.
5. Class IVB: Fat clays (CH)
    a. Plasticity index: above A line.
    b. Liquid limit: 50 or greater.
    c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
    d. Inorganic.
6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.2 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Division 31.

B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Owner's Representative, provided that physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:

1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8”	95 to 100
No. 4	60 to 80
No. 8	15 to 40

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2”	100
3/8”	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner’s Representative.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15”	15” – 8”	< 8”
1”	95 – 100	100	--
¾”	60 – 90	90 – 100	100
½”	25 – 60	--	90 – 100
3/8”	--	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 – 15
No. 8	--	0 – 5	0 – 5

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Division 31 to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Division 31.

K. Cement Stabilized Sand: Conform to requirements of Division 31.

L. Concrete Backfill: Conform to Class B concrete as specified in Division 32.

M. Flexible Base Course Material: Conform to requirements of applicable portions of Division 33.

2.3 MATERIAL TESTING

A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:

1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
2. Plasticity of material passing No. 40 sieve.
3. Los Angeles abrasion wear of material retained on No. 4 sieve.
4. Clay lumps.
5. Lightweight pieces.
6. Organic impurities.

B. Production Testing. Provide reports to Owner’s Representative from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.

C. Assist Owner’s Representative in obtaining material samples for verification testing at source or at production plant.

PART 3 E X E C U T I O N

3.1 SOURCES

A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.

B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Owner's Representative may obtain samples for verification testing.

C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner's Representative, expense for sampling and testing required to change to different material will be credited to Owner through change order.

D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.

E. Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.

B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

A. Quality Control

1. The Owner's Representative may sample and test backfill at:
    a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
    b. On-site stockpiles.
    c. Materials placed in Work.
2. The Owner's Representative may re-sample material at any stage of work or location if changes in characteristics are apparent.

B. Production Verification Testing: Owner's testing laboratory will provide verification testing on backfill materials, as directed by Owner's Representative. Samples may be taken at source or at production plant, as applicable.

END OF SECTION 31 06 20.17

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SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Removing surface debris and rubbish.

B. Clearing site of plant life and grass.

C. Removing trees and shrubs.

D. Removing root system of trees and shrubs.

E. Fence removal.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for clearing and grubbing is on per acre basis.
2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate clearing work with utility companies.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Verify that existing plant life and features designated to remain are identified and tagged.

3.2 PROTECTION

A. Protect following from damage or displacement:
1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
2. Plants other than trees and landscape features designated to remain.
3. Utilities designated to remain.
4. Bench marks, monuments, and existing structures designated to remain.

3.3 CLEARING

A. Remove stumps, main root ball, and root system to:

1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.
2. Depth of 24 inches below finished surface of required cross section for other areas.

B. Clear undergrowth and deadwood without disturbing subsoil.

C. Remove vegetation from top soil scheduled for reuse.

3.4 REMOVAL

A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Division 1.

B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF SECTION 31 11 00

SECTION 31 20 00

EARTH MOVING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Stockpiling of stripped topsoil in an approved location.
   02 Excavating for foundations and other improvements.
   03 Providing stable and compacted subgrade below buildings, concrete work and other improvements.
   04 Providing stable and compacted subgrade at excavations resulting from removal of tree, foundations and other foreign, underground objects / material removed from the site.
   05 Placing and compaction of select fill and general fill under improved areas to conform to elevations designated on the drawings.
   06 Transporting and mixing fill from onsite stockpile
   07 Filling and grading of the area around the building and improvements, using previously stripped topsoil, and any additional topsoil that must be purchased and delivered to the site.

C. Related Work:
   01 Section 02 32 00 – Geotechnical Investigation.
   02 Section 31 11 00 – Clearing and Grubbing.
   03 Section 31 22 19 – Finish Grading.
   04 Section 31 23 33 – Trenching and Backfilling.
   05 Section 31 32 13.19 – Lime Soil Stabilization.

1.2 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Name and location of fill pit(s) proposed to be used to furnish fill for the Work.

C. Description and historical test reports of select structural fill proposed to be furnished.

D. If select fill is to be a blended composition, provide description of methodology to be used for blending, and ratios of each type of material to be blended.

E. Sample: Provide a minimum of 1 cubic yard sample of proposed structural full material deposited on site. This sample shall remain on-site through the fill process and be used to visually compare subsequent fill brought to the site.

1.3 REFERENCES

A. American Society for Testing and Materials:
   01 ASTM D698-78, Test for Moisture Unit Weight Relations of Soils and Soil Aggregate.
   02 ASTM D2922, Tests for Density of Soil and Soil Aggregate in place by Nuclear Methods.
   03 ASTM D1557, Moisture Density Relations of Soils and Soil-Aggregate Mixtures.

1.4 QUALITY ASSURANCE

A. Testing Laboratory Services - Test results shall meet or exceed the standards referenced.

B. Proposers shall examine the job site conditions and be informed of all existing site conditions.

C. The Contractor will be required to establish, maintain and be responsible for all reference points, hubs, grades, elevations, lines, and surface measurements. If any discrepancies in the survey information furnished in the documents are found, the Contractor shall promptly notify the Architect and await instructions before proceeding.

PART 2 - MATERIALS

2.1 STRUCTURAL / SELECT FILL MATERIAL

A. Refer to Section 02 32 00 - Geotechnical Investigation Report.

B. Structural / select fill shall be lean clay, free from vegetation or other objectionable matter, reasonably free from lumps of the earth, and when tested in accordance with standard testing laboratory procedures shall meet the following requirements:
   01 The liquid limit shall not exceed 35.
   02 The plasticity index shall not be less than 10, and not more than 20.

C. If the only reasonable source of select fill provided from a source pit is a blend of sand and clay, the Contractor shall be solely responsible for quality control to assure that all material delivered to the project site matches the initial, approved test sample.
   01 Blended material that does not conform to the properties of the initial, approved test sample may be rejected at the job site whether installed or not.
   02 Coordinate with the source pit as required to assure quality control is maintained for all select fill delivered to the project site.

D. Structural / select fill shall be used to construct 100% of the building pad plus 3 feet beyond the building foundation, including below adjacent paved / concrete areas, including the following:
   01 Service Yard.
   02 Main entry concrete flatwork.
   03 Sidewalks / concrete flatwork directly adjacent to the building foundation.

E. Structural / select fill minimum amounts and thicknesses:
   01 Building pad to 3'-0" outside the perimeter: 12".
   02 Service Yard: Same as building pad.
   03 Main entry concrete flatwork: 12".
   04 Sidewalks / concrete flatwork directly adjacent to the building: 12" if outside the 3'-0" limit.

F. Disturbed subgrade below the depth of the building pad shall be filled with structural fill material and compacted in lifts as required to bring the disturbed area / excavation to rough grade elevation.
   01 Examples of disturbed subgrade areas includes but is not limited to: removal of unsuitable subgrade material, removal of existing trees, removal of existing buildings / foundations, removal of existing utilities, removal of tanks or similar foreign objects and materials.
   02 The use of on-site material shall not be accepted.

2.2 NON-STRUCTURAL FILL MATERIAL

A. Non-structural fill shall be silty clay, free of vegetation or other objectionable matter, reasonably free from lumps of the earth, and when tested in accordance with standard testing laboratory procedures shall meet the following requirements:
   01 The liquid limit shall not exceed 40.
   02 The plasticity index shall not be more than 20.

B. Non-structural fill material may be used to achieve rough grades at paving / flatwork areas not adjacent to the building and other in unimproved areas.
   01 Refer to soil Geotechnical Investigation Report and section 31 32 13.19 – Lime Soil Stabilization for additional requirements for subgrade at paving and flatwork.

C. Disturbed subgrade below the depth of required subgrade at paving, flatwork, sidewalks, and new site utilities shall be filled with non-structural fill material and compacted in lifts as required to bring the disturbed area / excavation to rough grade elevation.
   01 Examples of disturbed subgrade areas includes but is not limited to: removal of unsuitable subgrade material, removal of existing trees, removal of existing buildings / foundations, removal of existing utilities, removal of tanks or similar foreign objects and materials.

2.3 TOPSOIL

A. The Contractor shall furnish all additional topsoil that may be required to provide finish elevations and landscaping and sodding requirements.

B. Topsoil fill material shall be free of debris, stumps, roots and stones larger than 3/4 inch diameter. Earth / clay balls shall be broken down to a maximum 1-1/2" diameter size.

C. Topsoil must be suitable for rapid grass growth and shall contain a minimal amount of clay.

D. Topsoil shall be a proportional, homogeneous blend of fertile native soil, sand and organic matter / compost specifically blended for rapid grass growth with minimal to no clay.

E. Samples of topsoil shall be submitted to the Architect and Owner for approval prior to installation.

F. Topsoil previously stripped and stockpiled may be used provided it meets all provisions of this paragraph / section.

G. Contractor shall treat existing / previously stripped topsoil to remove all undesirable vegetation, weeds and similar material not conducive to finish grading work and planting of new material / grass.

H. During finish grading, provide a minimum of 2" of topsoil over all areas disturbed by construction activities. Refer to other sections for additional topsoil requirements at sports fields.

PART 3 - EXECUTION

3.1 PREPARATION

A. Unknown Utilities and Obstacles:
   01 Prior to the start of excavation, coordinate with the Owner to identify and locate known underground utilities and potential obstructions.
   02 If any unknown or uncharted utilities or objects which would be utilities are encountered during excavation, promptly notify the Architect and Owner before proceeding.
   03 Do not proceed until all conflicts are fully resolved.

B. Clearing, Stripping and Grubbing: Refer to section 31 10 00 – Site Clearing.

C. Protection of Trees:
   01 Where trees are indicated to remain, stop topsoil stripping at drip line to prevent main root system damage.
   02 In all construction areas, provide approved barricades around the drip lines of trees and shrubs, to protect them from construction operations until Substantial Completion, or until barricade removal is directed by Architect.
   03 Replace damaged trees and vegetation designated to remain with vegetation of equal kind and size. Follow supplier's recommended procedures for planting necessary replacement vegetation, and per direction of the Architect.

D. Excavating:
   01 Excavate to elevations and dimensions indicated and required, plus sufficient space to permit erection of forms, and select fill.
   02 Footing: Floor and wall excavations shall be finished level. Protect bottom of excavation from frost. Shore and brace excavations, protect all slopes and earth banks, and provide sheet piling, if necessary, to prevent cave-in. Remove shoring and piling before backfilling is completed, but not until permanent supports are in place.
   03 Grading: Contractor shall control the grading around building so that ground is pitched to prevent water from running into the excavated areas of building or damaging other structures. Furnish pumping required to keep excavated spaces clear of water during construction. If a foundation excavation must remain empty through a shut-down period,

cover with boards and building paper, and clean out immediately prior to placing concrete. If any subgrade should be damaged due to flooding, damaged area shall be removed and filled with select fill. Placement and compaction of select fill shall meet the requirements for placing and compacting of select fill.

E. Preparation of Building and Paving Subgrade:

01 After the topsoil has been removed and stockpiled in an approved location and the subgrade has been grubbed and cut to proper elevation, scarify and compact the top 6 inches of existing subgrade to a dry density not less than 95%, nor greater than 98% Standard Proctor Density. Should the cut elevation be below the grubbing depth, scarify and compact the top with 6 inches of new subgrade to a dry density not less than 95%, nor greater than 98% Standard Proctor Density.

02 In areas where paving subgrade is on select fill, subgrade preparation may be performed as specified in part 3.2-A-03.

03 Unstable Areas: Proof roll the entire area with a rubber-tired vehicle such as a loaded 10-yard dump truck, large maintainer or other suitable vehicle weighing approximately 20 tons. If unstable areas are encountered, over-excavate and remove the unstable material and replace with the specified type of select fill. Placement and compaction of select fill in unstable areas shall meet the requirements for placing and compacting of select fill.

04 The subgrade shall be compacted using a sheep's foot roller or other approved methods which will assure bonding of layers of fill material.

05 Contractor shall be responsible for any damage caused to existing structure because of over-excavation or excavations left open during inclement weather.

06 Should the subgrade, due to any reason or cause, lose the required stability, density, or finish before the pavement structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

07 Preparation of Subgrade In Inclement Weather: The Contractor may encounter difficulty in densifying/preparing the surficial soil depending on weather conditions. If inclement weather causes the surficial soils to become unsuitably wet, the Contractor will have one of the following options:

a. Adequately dry the surficial soils by discing these materials.

b. Dry the surficial soils by blending hydrated lime or fly ash with the unsuitably wet soils.

c. Remove the unsuitably wet soils and replace the wet soil with select fill having an acceptable moisture content.

This option will be entirely up to the Contractor. No extra will be paid by the Owner.

3.2 PLACEMENT

A. Select Fill:

01 Use under all building slabs, paving, sidewalks or other improved areas requiring fill, and to replace unstable subgrade.

02 Provide and place select fill when existing subgrade is in satisfactory condition, as determined by the testing laboratory.

03 Place under laboratory control, in layers of not more than 8 inches in loose thickness, at moisture contents at or above optimum, and compacted to densities of at least 95% of Standard Proctor Density, as

determined by ASTM D698 test procedure and within 2% of optimum moisture content.

04 Compaction of the select fill shall be accomplished by means of sheep's foot rollers or other approved methods which will assure bonding of layers of fill material.

B. General Earth Fill:

01 During construction, perform rough grading as required to provide positive drainage of the site.

02 Place general fill and rough grading in unimproved areas.

03 Rough grade to achieve elevations indicated allowing for installation of required top soil, landscaping and sodding.

04 Compact rough graded areas to densities of at least 95% of Standard Proctor Density, as determined by ASTM D698 test procedure and within 2% of optimum moisture content.

05 Re-grade and re-compact any areas that do not retain grade prior to placement of top soil.

06 Refer to Section 31 22 19 – Finish Grading.

PART 4 - TESTING LABORATORY SERVICES

A. Refer to Section 01 45 29 – Testing Laboratory Services.

B. Testing lab services shall be provided by a lab under direct contract with the Owner. Contractor shall be responsible for scheduling all testing services required for excavation and fill.

C. The Contractor shall be solely responsible for remedy of non-compliant materials and / or test results, including proceeding with subsequent fill installation prior to receiving conclusive test reports from the lab.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Removal of topsoil.

B. Rough grading the site for site structures, building pads, and play fields.

C. Replacement of topsoil and finish grading for planting.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 PROJECT CONDITIONS

A. Protect above- and below-grade utilities that remain.

B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

C. Protect bench marks survey, control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Topsoil - Soil Type : Topsoil excavated on-site.
   1. Graded.
      a. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.
      b. Provide imported topsoil conforming to the requirements of Division 32 as required.
   2. Other Fill Materials: Reference relevant sections of Division 32 and the Drawings.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

A. Identify required lines, leveler contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect utilities that remain, from damage.

D. Notify utility company to remove and relocate utilities.

3.3 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or degraded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. See Division 31 Specifications for filling procedures.

G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.

H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL

A. Stockpile excavated topsoil on site.

B. Stockpile excavated subsoil on site.

C. Stockpiles: Use areas designated on site, pile depth not to exceed 8 feet (2.5 m); protect from erosion.

3.5 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove/Break-up soil clumps greater than 1” in size. Remove soil contaminated with petroleum products.

C. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).

E. Place topsoil in areas where seeding is indicated.

F. Place topsoil where required to level finish grade.

G. Place topsoil to the following compacted thicknesses:
   1. Areas to be Seeded with Grass: 6 inches (150 mm).
   2. Areas to be Sodded: 4 inches (100 mm).

H. Place topsoil during dry weather.

I. Remove roots, weeds, rocks, and foreign material while spreading.

J. Near plants spread topsoil manually to prevent damage.

K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

L. Lightly compact placed topsoil.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10 foot (30 mm) from required elevation.

B. Top Surface of Finish Grade: Plus or minus 1/2 inch (13 mm).

3.7 FIELD QUALITY CONTROL

A. See Division 1 and Division 31 for compaction density testing.

3.8 CLEANING AND PROTECTION

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water. Excess topsoil and subsoil to be removed at no additional cost to owner.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 31 22 00

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SECTION 31 22 19

FINISH GRADING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Fine grading to meet required finish elevations indicated on the Drawings; distribution of top-soil over the site; and coordination with installation of sodding and landscaping.
   02 Disc the existing and / or filled subgrade to a depth of 6 inches using a landscape scarifier.
   03 Remove all roots, rocks, stumps, trash and all construction debris prior to rough grading.
   04 Following the removal of all foreign materials, and when the rough grading is completed, provide and place previously stripped material or silty or sandy clay material in the amounts required to bring the rough grade to within 2 inches of finish grade.
   05 Assure bonding of layers of fill material by discing in compliance with the specifications.
   06 Spread 2 inches of topsoil over graded areas after rough grading has been completed and approved unless indicated otherwise on civil or landscaping drawings.
      a. Topsoil previously stripped and stockpiled may be used, provided it meets all requirements for topsoil (Refer to Section 31 22 00 – Earth Moving).
      b. The Contractor shall furnish all additional topsoil that may be required to provide finish elevations.
      c. Existing topsoil and additional topsoil fill material shall be free of debris, stumps, roots and stones larger than 3/4 inch diameter.
      d. Samples of topsoil shall be submitted to the Architect and Owner for approval prior to installation.
      e. Topsoil must be suitable for rapid grass growth with little to no clay.
   07 Final and fine grading shall be done using a tractor pulled landscape rake and hand raking, removing all debris immediately prior to landscaping / hydro-mulching. The final graded ground surface shall be relatively smooth, free of organic material and all construction material debris; and in suitable condition to commence landscaping work.

C. Related Work:
   01 Section 02 32 00 – Geotechnical Investigation
   02 Section 31 11 00 – Clearing and Grubbing
   03 Section 31 20 00 – Earth Moving

04 Section 32 92 00 – Sodding & Hydromulching
05 Section 32 93 00 – Landscaping

1.2 PROJECT CONDITIONS

A. The Contractor will be responsible to maintain and control the grading around the building so that the grade is sloped to prevent water from ponding adjacent to or entering the building and / or accumulating in the graded areas throughout the progress of the Work.

B. Utilities and other remaining obstacles shall be properly identified prior to commencement of the final grading.

1.3 QUALITY ASSURANCE

A. Testing Laboratory Services. Test results shall meet or exceed the standards.

B. American Society for Testing and Materials:
01 ASTM D698-78, Test for Moisture Unit Weight Relations of Soils and Soil Aggregate.
02 ASTM D2922, Tests for Density of Soil and Soil Aggregate in place by Nuclear Methods.
03 ASTM D1557, Moisture Density Relations of Soils and Soil-Aggregate Mixtures.

PART 2- PRODUCTS

2.1 MATERIALS

A. Refer to Section 31 20 00 – Earth Moving for description of fill and topsoil materials.

PART 3- EXECUTION

3.1 FIELD QUALITY CONTROL

A. Preparation:
01 Upon completion of grading and prior to placement of topsoil, Contractor shall thoroughly remove all construction debris, weeds, foreign plants, rocks 3/4" diameter or larger, and other non-soil materials.
02 Remove by hand or hand rake if / where necessary.

B. Inspection:
01 The Contractor, prior to placing any topsoil, shall contact the Architect and Owner when the grading is complete and all foreign materials have been removed, to review these areas for compliance with the contract requirements.
02 Prior to placement of any topsoil, the Architect and Owner will review with the Contractor the areas designated complete and ready for final grading.
03 The topsoil installation shall proceed immediately when the designated areas have been reviewed and determined acceptable.

04 The Contractor shall contact the Architect and Owner to review the areas when the topsoil has been placed, debris removed, and all final grading has been completed.

05 This review shall occur prior to any sodding, seeding, hydro-mulching, and/or other landscaping operations proceeding within these designated areas.

06 Any construction materials, discovered or uncovered during and / or after the landscaping / sodding operations, shall be the responsibility of the Contractor to remove and replace each area to its finished condition.

3.2 INSTALLATION

A. Work under this Section consists generally of the following operations:

01 Disc the existing and / or filled subgrade to a depth of 6 inches using a landscape scarifier.

02 Place topsoil material in the amounts required to bring the rough grade to within 2” of finish sodded grade; and within 1” of areas to receive hydro-mulch unless indicated otherwise on civil or landscaping drawings.

03 Assure bonding of layers of fill material by discing in compliance with the specifications.

04 Final and fine grading shall be done using a tractor pulled landscape rake and hand raking, removing all debris immediately prior to landscaping / sodding / hydro-mulching. The final graded ground surface shall be relatively smooth, free of organic material and all construction material debris; and in suitable condition to commence landscaping work.

B. Solid Sodded Areas:

01 Grading at areas to receive solid sodding shall account for nominal thickness of root base / soil included in the solid sod blankets.

02 Grading at solid sodded area at building perimeter shall result in top of grass blanket soil flush with the bottom of the brick ledge, sidewalks and flatwork; unless shown otherwise on the Drawings.

03 Sodding shall not impede the drainage of water off or over sidewalks and flatwork.

04 Where solid sodding adjoins areas of hydro-mulched sodding, grade area to provide a level transition from one sodded area to the other after grass / hydro-mulch is established and fully rooted.

3.3 PROTECTION AND MAINTENANCE

A. The Contractor shall be responsible for the protecting and maintaining completed finish grading prior to the start of sodding and landscape work by the Owner.

B. Damage caused by surface run-off, construction vehicular traffic, use of equipment or other Contractor controlled activities shall immediately be repaired and restored to originally accepted state.

END OF SECTION

SECTION 31 23 16.14

TRENCH SAFETY SYSTEM

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Trench Safety System for the construction of trench excavations.

B. Trench Safety System for structural excavations that fall under provisions of State and Federal trench safety laws.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Measurement for Trench Safety Systems used on trench excavations is on a linear foot basis measured along the centerline of the trench, including manholes and other line structures.
2. No payment will be made for Trench Safety Systems for structural excavations under this section. Include payment for Trench Safety System in applicable structure installation sections.
3. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 DEFINITIONS

A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

B. The Trench Safety System requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.

C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Division 1.

B. Submit a safety program specifically for the construction of trench excavation. Design the Trench Safety Program to be in accordance with OSHA 29 CFR standards governing the presence and activities of individuals working in and around trench excavations.

C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.

D. Review of the safety program by the Engineer will only be in regard to compliance with this specification and will not constitute approval by the Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

1.5 REGULATORY REQUIREMENTS

A. Install and maintain Trench Safety Systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.

B. The Contractor is responsible for obtaining a copy of OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209.

C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., § 756.021 (Vernon 1991).

D. Reference materials, if developed for a specific project, will be issued with the Bid Documents.

1.6 INDEMNIFICATION

A. Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.

B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 P R O D U C T S – Not Used

PART 3 E X E C U T I O N

3.1 INSTALLATION

A. Install and maintain Trench Safety Systems in accordance with provisions of OSHA 29 CFR.

B. Install specially designed Trench Safety Systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.

C. A competent person, as identified in the Contractor's trench safety program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.2 INSPECTION

A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the Trench Safety Systems to ensure that the installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.

B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken by Contractor to safeguard personnel entering the trench.

C. Maintain a permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

A. Contractor shall verify specific applicability of the selected or specially designed Trench Safety Systems to each field condition encountered on the project.

END OF SECTION 31 23 16.14

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SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No additional payment will be made for trench excavation, embedment and backfill under this Section. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.
2. When Owner's Representative directs Contractor to over-excavate trench bottom, Contractor will be paid by unit price bid per linear foot under bid item - 6" Over-excavation of Trench Bottom.
    a. No payment will be paid if Owner's Representative does not direct Contractor to over-excavate trench bottom.
    b. No over-excavation will be measured or paid when unsuitable conditions result from dewatering system not in conformance with Division 1.
3. No additional payment will be made for performing Critical Location exploratory excavation. Include cost for unit price for work requiring critical location.
4. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.

F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.

I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Division 1.

K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
    a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
    b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
    c. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.

O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.

P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.

Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.

R. Trench Safety Systems include both protective systems and shoring systems as defined in Division 31.

S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave-in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.

U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

1.4 REFERENCES

A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.

B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.

C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).

D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.

K. TxDOT Tex-110-E - Particle Size Analysis of Soils.

L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.5 SCHEDULING

A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.6 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit planned typical method of excavation, backfill placement and compaction including:

1. Trench widths.
2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.

C. Submit backfill material sources and product quality information in accordance with requirements of Division 31.

D. Submit trench excavation safety program in accordance with requirements of Division 31. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.

E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

F. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Owner’s Representative.

1.7 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by Owner in accordance with requirements of Division 1 and as specified in this Section.

B. Perform backfill material source qualification testing in accordance with requirements of Division 31.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS

A. Have special shoring designed or selected by Contractor's Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre-manufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

PART 2 P R O D U C T S

2.1 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.

B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.

C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS

A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Division 31.

B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Division 31.

C. Geotextile (Filter Fabric): Conform to requirements of Division 1.

D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

E. Timber Shoring Left in Place: Untreated oak.

PART 3 E X E C U T I O N

3.1 STANDARD PRACTICE

A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

C. Classification of material will be determined by Owner’s Representative.

3.2 PREPARATION

A. Establish traffic control to conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.

B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Division 31.

C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Division 2, as applicable.

E. Install and operate necessary dewatering and surface-water control measures to conform to Division 1. Provide stable trench to allow installation in accordance with Specifications.

F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Division 1.

3.3 CRITICAL LOCATION INVESTIGATION

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on Drawings, field verify horizontal and vertical locations of such lines within zone 2 feet vertically and 4 feet horizontally of proposed work.

1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
2. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.

B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.

C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Owner's Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

3.4 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Division 1.

B. Protect and support above-grade and below-grade utilities which are to remain.

C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.

D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to the Owner.

3.5 EXCAVATION

A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.

B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

Nominal Pipe Size, Inches	**Minimum Trench Width, Inches**
Less than 18	O.D. + 24
18 to 30	O.D. + 24
36 to 42	O.D. + 36
Greater than 42	O.D. + 48

D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner's Representative and obtain instructions before proceeding.

F. Shoring of Trench Walls.

1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner's Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent

of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.

G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:

1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.
3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
5. Conform to applicable Government regulations.

H. Voids under paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports

I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.

J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company’s line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company’s representative.

K. When, during excavation to uncover pipeline company's pipelines, screwed collar or an oxy-acetylene weld is exposed, immediately notify Owner’s Representative. Provide supports for collar or welds. Discuss with Pipeline Company’s representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

3.6 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials, which are suitable as defined in this Section and conforming to Division 31. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming to requirements of Division 31.

C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with

Division 1. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

3.7 TRENCH FOUNDATION

A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

B. When wet soil is encountered on trench bottom and dewatering system is not required, overexcavate an additional 6 inches with approval by Owner's Representative. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.

C. Perform over excavation, if directed by Owner's Representative, in accordance with Paragraph 3.07B above. Removal of unstable or unsuitable material may be required if approved by Owner's Representative:

1. Even though Contractor has not determined material to be unsuitable, or
2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Division 1.

D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.8 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.

B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.

C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.

D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.

E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.

F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.

G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.

H. Place electrical conduit, if used, directly on foundation without bedding.

I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.

J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Division 31. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:

1. Class I, II and III Embedment Materials:
   a. Maximum 6 inches compacted lift thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
2. Cement Stabilized Sand (where required for special installations):
   a. Maximum 6 inches compacted thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.

3. Class I Embedment Materials.
   a. Maximum 6-inches compacted lift thickness.
   b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
   c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.
4. Class II Embedment and Cement Stabilized Sand.
   a. Maximum 6-inches compacted thickness.
   b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
   c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.

K. Place trench dams in Class I embedment in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.9 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.

B. For water lines, backfill in trench zone, including auger pits, intermediate and site pits, with bank run sand, select fill, or random backfill material as specified in Division 31.

C. For sewer pipes, use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot back of curb, use cement stabilized sand to level 12 inches below the pavement. For sewer pipes under natural ground backfill from 12 inches above top of pipe to 6” inches below finish grade with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement. Use topsoil for 6-inch backfill directly under natural grade. For backfill materials reference Division 31.

D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.

E. When shown on Drawings, random backfill of suitable material may be used in trench zone for trench excavations outside pavements.

F. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.

1. Class I, II, III or IV or combination thereof (Random Backfill):
    a. Maximum 9-inches compacted lift thickness.
    b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
    c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by Owner’s Representative.

2. Cement-Stabilized Sand:
    a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
    b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
    c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
3. Select Backfill:
    a. Place in maximum 8-inch loose layers.
    b. Compaction by equipment providing tamping or kneading impact to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
    c. Moisture content within 2 percent below or 5 percent above optimum determined according to ASTM D 698, unless approved by Owner’s Representative.

G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.

1. Fat clays (CH) may be used as trench zone backfill outside paved areas at Contractor's option. When required density is not achieved, at no additional cost to Owner, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use different suitable material.
2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D 698.
4. Moisture content as necessary to achieve density.

H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, INLETS, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

A. Meet requirements of adjoining utility installations for backfill of pipeline structures, as shown on Drawings.

B. Below paved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement.

C. In unpaved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of finish grade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use suitable on-site material and topsoil for the 12-inch backfill directly under natural ground.

3.11 FIELD QUALITY CONTROL.

A. Test for material source qualifications as defined in Division 1.

B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.

C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by Owner's Representative.

D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.

E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.

1. For open cut construction projects and auger pits: Unless otherwise approved by Owner's Representative, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.
2. A minimum of three density tests for each full shift of Work.
3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.

6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
7. Recompacted placement will be retested at same frequency as first test series, including verification tests.
8. Identify elevation of test with respect to natural ground or pavement.

F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.

G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Division 1.

END OF SECTION 31 23 33

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SECTION 31 32 13.19

SOIL STABILIZATION

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work: Provide soil stabilization below and to 36” beyond the limits of the following areas:
   01 Concrete paving parking areas, driveways and approaches
   02 Mechanical and kitchen service yards.
   03 Concrete flatwork areas, excluding sidewalks.

C. Related Work:
   01 Section 02 32 00 – Geotechnical Investigation
   02 Section 03 30 00 – Cast-In-Place Concrete
   03 Section 31 20 00 – Earth Moving
   04 Section 32 13 13 – Concrete Paving

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer’s literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Mix Design: Provide proposed mix designs to achieve required percentage when mixed with substrate fill material.

D. Installation Instructions: Submit manufacturer’s complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.

1.3 REFERENCES

A. ASTM International:
   01 ASTM C911 - Standard Specification for Quicklime, Hydrated Lime, and Limestone for Selected Chemical and Industrial Uses.
   02 ASTM C977 - Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization
   03 ASTM C618, Class C – Standard Specifications for Fly Ash

04 ASTM D698 - Tests for Moisture-Unit Weight Relations of Soils and Soil Aggregate.

B. Texas Highway Department Publications: Standard Specifications for Construction of Highways, Streets and Bridges
01 Item 260 – Lime Treatment (Road Mixed)
02 Item 263 – Lime Stabilization (plant Mixed)
03 Item 265 – Specification for Type B Slurry
04 Item 275 – Specification for Portland Cement (if selected)

C. Texas Department of Transportation Departmental Material Specifications (DMS), latest edition:
01 DMS 6350 – Lime and Lime Slurry.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Testing and Inspection Service: Contractor responsible to coordinate with the testing agency prior to start of Work requiring testing so as to minimize unnecessary cost or delays to the project.

C. Testing:
01 Owner will retain and pay a qualified Materials Testing Laboratory to take all field samples and do all laboratory testing necessary to verify compliance of the work to these Specifications or as required by City or other regulatory agencies.
02 All tests shall be performed by the Materials Testing Laboratory Materials Testing Laboratory in accordance with ASTM D 698, D1556, or other test method selected by Geotechnical Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lime - Flyash Slurry:
01 Lime slurry for use in treating the subgrade shall conform to the chemical and physical requirements listed in Tables 1 and 2 of TxDOT Departmental Material Specification (DMS) 6350 for Commercial Lime Slurry.
02 The selected Fly-Ash should be in accordance with ASTM C618, Class C; and have a minimum CaO content of 20 percent.

B. Portland Cement (if Selected) to meet TxDot Departmental Material Specifications

C. Water:
01 Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
02 Water sources other than the local municipal domestic water supply must be approved by the Civil Engineer.

PART 3 - EXECUTION

3.1 GENERAL

A. After preparatory work specified under Section 31 20 00 – Earth Moving has been satisfactorily completed and approved by the Testing Laboratory, a minimum of 6 inches of earth material which occurs at the top of the existing subgrade beneath all scope areas listed in Paragraph 1.1 shall be scarified, and a stabilized subgrade be installed.

01 Extend stabilization a minimum of 3 feet beyond the edge of the required areas.

B. Construction methods shall conform to the applicable specifications of the TxDOT specifications, Item 265, Type B Slurry.

C. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day.

3.2 APPLICATION

A. For estimating and planning, The percent of lime to the dry weight of the soil shall be a minimum of two to three percent (2% -3%) hydrated lime and seven to eight percent (7% - 8%) fly ash (by dry unit weight). Refer to Section 02 32 00 - Geotechnical Investigation.

B. The distribution of lime – fly ash shall be uniformly placed in such quantity that all soil to be treated receives the minimum percentage of lime and successive passes made until the proper moisture and lime – Fly ash content is obtained.

C. The distributor truck shall be equipped with an agitator which will keep the lime – fly ash and water in uniform mixture unless the prescribed consistency can be otherwise maintained. If an agitator is not used, a standby pump shall be available at the site for agitating the lime and water in case of delays in dispersing the slurry.

D. If cement modification is used, mixed with at least 4 percent Portland cement (by dry unit weight) in conformance with TxDOT Item 275. Assuming an in-place unit weight of 110 pcf for the pavement subgrade soils, this percentage of cement equates to about 20 lbs. Refer to Section 02 32 00 - Geotechnical Investigation.

E. Liquid lime soil stabilization products and materials shall be used when residences are within one-half mile in any direction from the facility site.

F. No dry-type lime soil stabilization shall take place when the adjacent elementary, intermediate, or high school campuses are occupied by students during the school day.

3.3 MIXING

A. The material and lime shall be thoroughly mixed by approved road mixers until a homogeneous, friable mixture of material and lime is obtained, free from all clods or lumps.

B. Immediately after the "first mixing" operation, the mixture shall be brought to the proper moisture content and sealed with a light pneumatic rubber tire roller and

left to cure for 1 to 4 days, as directed by the Owner. If rework is required to obtain compaction after 72 hours of the last mixing, add 25% of the specified rate of lime.

C. After curing time the material shall be uniformly mixed. All clods shall be reduced in size by raking, blading, discing, harrowing, scarifying or other approved method.

3.4 COMPACTION

A. Compaction of the mixture shall begin immediately after final mixing and in no case later than 3 calendar days after final mixing.

B. The moisture content at time of compaction shall be at optimum to two percent (2%) above optimum.

C. The mixture when used as pavement subgrade shall be compacted by sheepsfoot rollers or 25 ton pneumatic self-propelled rollers until a minimum density of 95% of Standard Maximum Density (ASTM D-698-07e1) is obtained.

END OF SECTION

SECTION 32 11 13.13

LIME-TREATED SUBGRADES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Foundation course of lime stabilized natural subgrade material.

1.2 MEASURMENT AND PAYMENT

A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM D698 - Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb Rammer and 12 inch Drop.

B. ASTM D1140 - Method of Test for Amount of Material in Soils Finer than the No. 200 Sieve.

C. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.

D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D3017 - Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

G. TxDOT Tex-600-J - Lime Testing Procedure.

H. Geotechnical Engineering Soils Report.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Division 1.

B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.5 TESTS

A. Testing will be performed under the provisions of Section - Testing Laboratory Services.

B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.

E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to sub grade material.

F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.

B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2P R O D U C T S

2.1 WATER

A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.2 LIME

A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.

B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:
1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.
2. Grade S: Finely-graded quicklime for use in the preparation of slurry for wet placing. Do not use grade S quicklime for dry placing.

D. Lime shall conform to requirements of Item 260 of the 1993 Texas Department of Transportation Standard Specifications.

E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3E X E C U T I O N

3.1 EXAMINATION

A. Verify compacted sub grade is ready to support imposed loads.

B. Verify sub grade lines and grades are correct.

3.2 PREPARATION

A. Complete backfill of new utilities below future grade.

B. Cut material to bottom of sub grade using an approved cutting and pulverizing machine meeting following requirements:
   1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.
   2. Visible indication that cut is to proper depth.

C. Alternatively, scarify or excavate to bottom of stabilized sub grade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

3.3 LIME SLURRY APPLICATION

A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.06C concerning use of quicklime.

B. Apply slurry with a distributer truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.

C. Apply so that dry sub grade will contain a minimum lime content of 7 percent by weight of dry sub grade unless otherwise instructed by Testing Laboratory.

3.4 PRELIMINARY MIXING

A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.

B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

C. Shape mixed sub grade to final lines and grades.

D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:
   1. Seal sub grade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.
   2. Cure soil-lime material for 1 to 4 days. Keep sub grade moist during cure.

3.5 FINAL MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.

C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.

D. Shape mixed sub grade to final lines and grades.

E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.6 COMPACTION

A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

B. Start compaction immediately after final mixing, unless approved by Engineer.

C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.

D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.

E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:
   1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.
   2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.

G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.

3.7 CURING

A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Sub grade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep sub grade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from the Engineer.

3.8 TOLERANCES

A. Completed surface shall be smooth and conform to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16 foot length.

3.9 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section - Testing Laboratory Services.

B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.

C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.
   1. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at random locations near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.

D. Fill test sections with new compacted lime stabilized sub grade.

3.10 PROTECTION

A. Maintain stabilized sub grade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.

B. Repair defects immediately by replacing material to full depth.

END OF SECTION 32 11 13.13

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SECTION 32 13 13

CONCRETE PAVING AND FLATWORK

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work: Provide all exterior concrete paving, as indicated on the Drawings; including, but not necessarily limited to:
   01 Concrete parking areas, driveways and curbs.
   02 Concrete sidewalks.
   03 Service yards.
   04 Activity and sports areas.
   05 Ramps and steps.
   06 Site light bases.
   07 Drainage structures.
   08 Other concrete flatwork as indicated on the Drawings.

C. Related Work:
   01 Section 01 45 23 – Testing and Inspection Services
   02 Section 03 30 00 – Cast-In-Place Concrete
   03 Section 31 20 00 – Earth Moving
   04 Section 31 22 19 – Finish Grading
   05 Section 31 32 13.19 – Lime Soil Stabilization

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Proposed mix designs, including adequate historical documentation to substantiate performance and strengths.

D. Shop Drawings:
   01 Shop Drawings for all reinforcing steel. Show bending diagrams, splicing and laps of rods, shapes, dimension and details of bar reinforcement and accessories.
   02 Shop Drawings showing location of all proposed construction and control joints, keying / keyways, water stops, openings, depressions, trenches, sleeves, inserts, and other items affecting reinforcement and placement of concrete.
   03 Placement sequence schedule (may be combined with Item 02).

04 Unless shown on the Site Plan, submit proposed layout for all expansion joints in paving, flatwork and sidewalks.

E. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
02 Generic details that do not depict actual conditions shall not be acceptable.

F. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

G. Samples of Proposed Materials: Provide two (2) actual samples of the following products:
01 Plastic chair rebar supports.
02 Slab membrane(s) and tape(s); 8" x 10" minimum membrane and 12" minimum tape.
03 Water stops; minimum 6" length.
04 Colored Concrete at Ramps: full range of manufacturer's available colors selections for colored concrete.
a. May begin with digital images.
b. Architect shall select up to four (4) colors for Contractor to submit actual samples of.

H. Tests and Certifications:
01 Before starting any work under this section, make all required arrangements with the testing agency. The testing laboratory shall test and furnish certified reports on proposed cements, aggregates, mixing water and admixtures.
02 Submit proposed design mixes for each type of concrete using previously tested and approved materials.
03 Furnish certified reports of each proposed mix for each type of concrete.
04 Proportion mixes by laboratory trial batch or field experience methods, using materials to be employed in the work for each class of concrete required, and report to the Architect.
05 Refer to Section 01 45 23 – Testing and Inspection Services for on-site procedures and testing requirements.
06 Furnish ready mix delivery tickets.

1.3 REFERENCES

A. Refer to Section 03 30 00 – Cast-In-Place Concrete.

B. The current editions of the following documents govern the work, except where more restrictive items are specified.
01 Standard Specifications for Construction of Highways, Streets, and Bridges by Texas Highway Department.

02 Texas Department of Transportation.

PART 2 - PRODUCTS

2.1 PAVING / CONCRETE MATERIALS

A. Compacted Sub-Base: as specified in Section 31 20 00 – Earth Moving and 31 32 13.19 – Lime Soil Stabilization.

B. Concrete Material:
- 01 Refer to Section 03 30 00 – Cast-In-Place Concrete for general provisions of concrete material.
- 02 Aggregate shall be limestone at paving.
- 03 All concrete used for paving shall have a minimum compressive strength of 3000 PSI unless a higher strength is identified in the soil investigation / Geotechnical Report.
- 04 All concrete used for sidewalks and concrete flatwork shall have a minimum compressive strength of 3000 PSI.

C. Forms: steel, wood, or other suitable material(s) of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
- 01 Use straight forms free from distortion and defects. Use flexible spring steel forms or laminated boards to conform to radius bends as required.
- 02 Form Coating: a non-staining form release agent that will not discolor or deface surface of concrete.

D. Reinforcing Bars: deformed billet steel bars.
- 01 Comply with provisions of Section 03 30 00 – Cast-In-Place Concrete.

E. Rebar Chairs and Spacers:
- 01 OCM, Inc. – “Plastic Cradle Chair”.
- 02 Aztec “Castle Chair”.
- 03 Heavy-duty plastic-type sized to support all slab steel at proper height.
- 04 Use type with sand cushion pads where concrete is on grade.

F. Construction Joints:
- 01 Metal Keyway: tongue and groove joint, 5" wide, 24 gauge, galvanized with 18-gauge stake pins; Heckman Building Products, Model 95-50; or approved equal.

G. Flexible Expansion Joints:
- 01 Expansion Joints - Flexible: Asphalt impregnated fiberboard, ½” wide in sizes required. All joints shall be sealed continuous with an approved paving joint sealer.
- 02 To be installed continuously at all flatwork-to-building conditions.
- 03 Cap sealant: Comply with Fed. Spec. TT-S-00227E “Two Component”, 100% Urethane (light grey). All joints shall be sealed continuous.

H. Load Transfer Units:
- 01 Sidewalks: 3/4 inch thick redwood form with 1/4 inch deep removable top strip, 1/2” x 10" steel reinforcing bars at 15 inches O.C. +/- with bond breaker sleeve on one side.

02 Paving: 3/4 inch thick redwood form with 1/4 inch deep removable top strip, 3/4” x 12" steel reinforcing bars at 12 inches O.C. +/- with bond breaker sleeve on one side.

03 Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.

I. Decorative Wood Joints: Where indicated in the Drawing, provide construction heart grade redwood joints conforming to AASHO-M-90. Provide sizes indicated on the Drawings. Do not install adjacent to curbs.

J. Control Joints: Tooled Joint:

01 Scored Joints: Tool edged joints, 3/16” to 1/4" wide; depth shall be 1/4 the thickness of the concrete in depth. Score as soon as practical after initial concrete placement.

02 Saw-Cut Joints: Machine cut saw joints shall be 1/4 the thickness of the concrete paving. Installation with hand held saw is not permitted. Saw cut joints as soon as practical (4 to 8 hours after placement) for cut edge to not chip or spall.

03 Zip Joints: Not permitted.

K. Concrete Materials: Comply with the requirements of Section 03 30 00 – Cast-In-Place Concrete for concrete materials, admixtures, curing materials, and others as required.

L. Paving Joint Sealant:

01 Self-leveling polyurethane sealant specifically formulated for use in pavement / concrete expansion joints.

02 BASF MasterSeal SL-2; or approved equal.

03 Pavement joint sealer alternative: Tex-Trude Tex-Cap high performance modified PVC joint cap.

2.2 INTEGRAL COLORED CONCRETE

A. Integral Colored concrete is based on products / systems manufactured by Bomanite.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this section, provide all proposed products meet or exceed the specified requirements.

01 Davis Colors

02 L.M. Scofield

03 New Riverside Ochre Co., Inc.

C. Integral Coloring Admixture: Integral Color by Bomanite Corporation, synthetic oxide pigment, meeting ASTM C979 and C494; or approved equal. Color as selected by Architect from full range of manufacturer’s colors.

01 Provide at all areas indicated on the Drawings to be integral colored concrete.

02 Provide at all ramps as required by Americans with Disabilities Act and Texas Department of Licensing and Registration “Texas Accessibility Standards”.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Prior to all Work of this Section, carefully inspect the installed Work of all other trades, and verify all such Work is complete to the point where this installation may properly commence. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

B. Remove all loose material from compacted sub-base immediately prior to placing concrete.

C. Verify that forms have been set to the grades and lines required and that they are rigidly braced and secured.

3.2 ENVIRONMENTAL CONDITIONS

A. Temperature:
   01 Do not place concrete in contact with frozen earth.
   02 Do not commence concrete placement unless temperature is at least 35°F (2°C) and rising, or slabs until the temperature rises above 40°F.
   03 Discontinue concrete placement when air temperatures exceed 95°F.

B. Do not place concrete during rain unless adequate protection is provided.

3.3 INSTALLATION – PAVING / FLATWORK JOINTS

A. General:
   01 Construct all joints true-to-line with face perpendicular to surface of concrete.
   02 Do not install joints which create acute angle shaped edges at the perimeter of the pavement sections. Minimum angle allowed shall be 60 degrees.

B. Load Transfer Joints: Unless specifically shown on the Drawings, the Contractor shall locate load transfer joints in accordance with the following schedule:
   01 Sidewalks: maximum distance between load transfer joints shall be 4 times the sidewalk width. Provide scored control joints in between expansion joints in equal intervals +/- the width of the sidewalk.
   02 Pavement Areas: load transfer joints shall be placed in each direction, in regular and evenly spaced intervals, to create pavement sections not to exceed 625 sq. ft. in a maximum size ratio of 1:1.5. Layout of proposed joint pattern must be approved by the Architect prior to installation.
   03 Seal all load transfer joints, continuous.

C. Redwood Expansion Joints:
   01 Isolate all catch basin and inlet grates with redwood expansion joints set in a diamond shape approximately 12” beyond the edge of the grate frame. Points of the diamond should correspond to load transfer joints.
   02 Install redwood expansion joints at all sidewalk and flatwork joints that are not otherwise load-transfer joints.
   03 Seal all redwood joints, continuous.

D. Construction joints: obtain approval of Architect for locations and types of all proposed construction joints.

E. Flexible Expansion Joints:
   01 Isolate all catch basin and inlet grates with flexible expansion joints set in a diamond shape approximately 12” beyond the edge of the grate frame. Points of the diamond should correspond to load transfer joints.
   02 Install flexible expansion joints at all locations where flatwork or pavement is poured against a building foundation or other structural footing / beam.
   03 Seal all flexible expansion joints, continuous.

F. Curing Compound:
   01 Apply at all exterior concrete surfaces.
   02 Apply complete covering of curing compound as soon as concrete is finished in strict accordance with manufacturer's standards and recommendations.
   03 Coordinate with other trades as required to assure compatibility with any finishes to be applied over concrete surfaces.

3.4 INSTALLATION – PAVING / FLATWORK

A. Concrete Placement:
   01 General: Comply with the provisions as specified in Section 03 30 00 – Cast-In-Place Concrete.
   02 Deposit and spread concrete in a continuous operation. If interrupted for more than 45 minutes, place a construction joint.
   03

B. Finishing:
   01 All concrete flatwork and sidewalks shall receive a light broom finish, perpendicular to the run of the sidewalk.
   02 All concrete pavement shall receive a medium broom finish, parallel to the direction of drainage.

C. Curing Compound:
   01 Apply at all exterior concrete surfaces.
   02 Apply complete covering of curing compound as soon as concrete is finished in strict accordance with manufacturer's standards and recommendations.
   03 Coordinate with other trades as required to assure compatibility with any finishes to be applied over concrete surfaces.

D. Repairs and Protection:
   01 After form removal, clean ends of joints and point up any minor honey combed areas. Repair or replace broken or defective concrete, as directed by the Architect.
   02 Protect concrete from damage until acceptance of Work. Exclude traffic from pavement for at least seven (7) days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.
   03 Sweep all concrete pavement and wash free of stains, discolorations, dirt, and all other foreign materials just prior to final inspection.

3.5 CLEANING AND PROTECTING - CONCRETE

A. Protect concrete paving and flatwork from damage during construction period. In the event of damage, make all necessary repairs and / or replacements required.

B. Clean and prep concrete paving and curbs prior to striping and painting. Adhere to paint manufacturer's specifications and recommendations.

C. Prior to final acceptance, thoroughly clean all paving and concrete work. Remove all tire tracks, rust stains, oil stains, dirt, excessive sealant, and other debris form the finished surface.

END OF SECTION

SECTION 32 13 13.10

CONCRETE PAVEMENT CURING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Curing of Portland cement concrete paving.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving, Concrete Sidewalks, Concrete Driveways, Curbs, and Curb and Gutters.
2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.

B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.

C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

PART 2 P R O D U C T S

2.1 COVER MATERIALS FOR CURING

A. Conform curing materials to one of the following:

1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.
2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.
3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

2.2 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m2 in 72 hours using test method ASTM C 156.

PART 3 E X E C U T I O N

3.1 CURING REQUIREMENT

A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.

B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.2 POLYETHYLENE FILM CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.

B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

3.3 WATERPROOFED PAPER CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.

B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

3.4 COTTON MAT CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.

B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

3.5 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.

C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by Owner's Representative, but not less than one gallon per 200 square feet of surface area.

3.6 TESTING MEMBRANE

A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface.

B. Re-Apply membrane compound immediately at no cost to Owner when membrane fails above test.

END OF SECTION 32 13 13.10

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SECTION 32 13 13.25

CONCRETE SIDEWALKS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Reinforced concrete sidewalks.

B. Wheelchair ramps.

C. Reinforced slope paving.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for concrete sidewalks is on square foot basis.
2. No payment will be made for work outside these limits or in areas where driveway has been removed or replaced for Contractor's convenience.
3. Payment for wheelchair ramps of each type specified is on square foot basis. Removal and replacement of existing sidewalk, curb or curb and gutter and saw-cutting is paid by unit cost for each item. Sodding will be paid one foot on each side of sidewalk unless otherwise noted. Staining of wheelchair ramps is included in cost of ramp.
4. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.

B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).

H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statues.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit certified testing results and certificates of compliance.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Division 32.

B. Reinforcing Steel: Conform to material requirements of Division 32. Use No. 3 reinforcing bars.

C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.

D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Division 31.

E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.

F. Sand Bed: Conform to material requirements for bank run sand of Division 31.

G. Sodding: Conform to material requirements for sodding of Division 31.

H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Division 31. Color shall be Brick Red or as shown on the drawings.

PART 3 E X E C U T I O N

3.1 REPLACEMENT

A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.

B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

3.2 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations in accordance with Division 31.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance with Division 31. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.

E. Immediately after subgrade is prepared, begin form work and concrete placement.

3.3 PLACEMENT

A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.

B. Reinforcement:

1. Install reinforcing bars.
2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.
3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.
5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

C. Expansion Joints: Install expansion joints with load transfer units in accordance with Division 32.

D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

F. Apply coating to wheelchair ramp with contrasting color in accordance with Division 32.

G. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

H. Finish edges with tool having 1/4 inch radius.

I. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Division 1. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Division 32.

3.4 CURING

A. Conform to requirements of Division 32.

3.5 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Division 1.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that

is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. If the Contractor places concrete without notifying the laboratory, the Owner will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.

E. Sampling of fresh concrete shall be in accordance with ASTM C 172.

F. Take slump tests when cylinders are made and when concrete slump appears excessive.

G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.

H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.

I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Owner's Representative. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

3.6 NONCONFORMING CONCRETE

A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.

B. Replace nonconforming sections at no additional cost to Owner.

3.7 PROTECTION

A. Maintain newly place concrete in good condition until completion of Work.

B. Replace damaged areas.

END OF SECTION 32 13 13.25

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.

B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for street pavement expansion joints, with or without load transfer, is on linear foot basis.
2. Payment for horizontal dowels is on a unit price basis for each horizontal dowel.
3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.
4. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.
5. Payment will be made for Preformed Expansion Joints on a linear foot basis only when field conditions require that sidewalk be moved adjacent to existing concrete structure (i.e., street, back of curb, etc.).
6. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.

E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit product data for joint sealing compound and proposed sealing equipment for approval.

C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

PART 2 P R O D U C T S

2.1 BOARD EXPANSION JOINT MATERIAL

A. Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.2 PREFORMED EXPANSION JOINT MATERIAL

A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.3 JOINT SEALING COMPOUND

A. Provide joint sealant as indicated on the drawings.

2.4 LOAD TRANSMISSION DEVICES

A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.5 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Owner’s Representative.

PART 3 E X E C U T I O N

3.1 PLACEMENT

A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling, or cracks.

3.2 CONSTRUCTION JOINTS

A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.3 EXPANSION JOINTS

A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart or as shown on the drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

3.4 CONTRACTION JOINTS

A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.5 LONGITUDINAL WEAKENED PLANE JOINTS

A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.6 SAWED JOINTS

A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.7 JOINTS FOR CURB, CURB AND GUTTER

A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

3.8 JOINTS FOR CONCRETE SIDEWALKS

A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 40 feet.

3.9 JOINTS FOR CONCRETE DRIVEWAYS

A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.

B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Owner's Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.

B. Replace damaged joints material with new material as required by this Section.

END OF SECTION 32 13 73

SECTION 32 16 13

CURB AND GUTTERS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.

B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for curbs, curbs and gutter, and esplanade curbs is on linear foot basis measured along face of curb.
2. Payment for 3 foot concrete valley gutter is on a linear foot basis.
3. Payment for mountable concrete curbs is on a square foot basis.
4. Payment for concrete paving headers and concrete railroad headers is on a linear foot basis.
5. Payment for headers is on linear foot basis measured between lips of gutters adjacent to concrete base and measured between backs of curbs adjacent to concrete pavement.
6. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit details of proposed form work for approval.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Concrete: Conform to material and proportion requirements for concrete of Division 32.

B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Division 32.

C. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to following requirements.

1. Compressive strength
   a. at 7 days: 3500 psi
   b. at 28 days: 4000 psi
2. Initial set time: 45 minutes
3. Final set time: 1.5 hours

D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.

E. Expansion Joint Filler: Conform to material requirements for expansion joint filler of Division 32.

F. Mortar: Mortar finish composed of one part Portland cement and 1 1/2 parts of fine aggregate. Use only when approved by Owner's Representative.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Prepare subgrade in accordance with applicable portions of sections on excavation and fill, embankment, and subgrade and roadbed.

3.2 PLACEMENT

A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Ensure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.

B. Forms: Brace to maintain position during pour. Use metal templates cut to section shown on Drawings.

C. Reinforcement: Secure in position so that steel will remain in place throughout placement. Reinforcing steel shall remain at approximate center of base or pavement as indicated on Drawings.

D. Joints: Place in accordance with Division 32. Place dummy groove joints at to match concrete pavement joints at right angles to curb lines. Cut dummy grooves 1/4 inch deep using approved edging tool.

E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

3.3 MANUAL FINISHING

A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.

B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.

C. Before applying final finish move 10 foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.

D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.

E. Edge outer edge of gutter with 1/4 inch edger. Finish edges with tool having 1/4 inch radius.

F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

3.4 MECHANICAL FINISHING

A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, when approved by Owner's Representative. Use of mechanical methods shall provide specified curb design and finish.

3.5 CURING

A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Division 32.

3.6 TOLERANCES

A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of straightedge laid along them, except at grade changes.

3.7 PROTECTION

A. Maintain curbs and gutters in good condition until completion of Work.

B. Replace damaged curbs and gutters to comply with this Section.

END OF SECTION 32 16 13

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SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This Section specifies the requirements for providing pavement markings of the following types.

1.02 UNIT PRICES

A. Measurement and payment for pavement markings is on a lump sum basis.

1.03 QUALITY ASSURANCE

A. All markings shall comply with the requirements of the SDHPT Standard Specifications for Construction of Highways, Streets and Bridges, the SDHPT Manual on Uniform Traffic Control Devices for Streets and Highways and the applicable regulations and standards of Harris County, Texas, and the City.

B. Reference Standards Applicable to this Section:

1. SDHPT: Texas State Department of Highways and Public Transportation:

a. Standard Specifications for Construction of Highways, Streets and Bridges.
b. Texas Manual on Uniform Traffic Control Devices for Streets and Highways (TMUTCD).
c. The above referenced SDHPT standards may be obtained from:

State Department of Highways & Public Transportation Highway Building
11th and Brazos Streets
Austin, Texas 78701
Tel: (512) 475-2081

2. Conform to current federal VOC (Volatile Organic Compounds) regulations.

1.04 SUBMITTALS

A. Certificates:

1. Certificates shall be submitted for each product indicating that the product complies with the requirements of this specification.

B. Manufacturer's Data:

1. Manufacturer's installation instructions, specifications and recommendations shall be submitted for each pavement marking product.

1.05 JOB CONDITIONS

A. Markings shall be installed only on clean and dry surfaces. Paint markings shall be applied only when surfaces have the following minimum temperatures:

1. A minimum of 50 degrees F for asphalt and a minimum of 60 degrees F for concrete.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Paint:

1. Marking paint shall be traffic white, yellow, or as designated on the drawings.
2. Fast Drying Alkyd, Low VOC Chlorinated Rubber Traffic Paint.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Surface condition / preparation: Asphalt and concrete surfaces should be cured, clean, dry and sound. Loose and lifting paint should be removed prior to application. Concrete with sealers containing silicone, having a smooth finish, or efflorescence should be removed by etching or abrasive blasting, as these conditions may interfere with adhesion. While new asphalt surfaces vary in length of time required for curing, insufficient curing may result in bleeding. Not recommended for use over asphalt sealers. Regardless of surface condition, a test stripe should be placed inconspicuously to determine if surface is suitable before continuing.

B. Markings shall be installed, and surfaces prepared in accordance with the requirements of the applicable item in the SDHPT Standard Specifications and the TMUTCD.

C. Markings shall be protected from vehicular traffic until not subject to damage by such traffic. Contractor shall be responsible for repair and replacement of markings until written acceptance by the Owner.

END OF SECTION 32 17 23

SECTION 32 18 23.26
NATURAL FIELD SPORT SURFACING

PART 1 GENERAL

1.1 SCOPE

A. This section specifies Texas Certified Tifway 419 Hybrid Bermuda Sod for installation on the playing fields as well as selected open areas off the playing fields.

1.2 RELATED WORK

A. Division 32, Exterior Improvements
1. 32 18 23.27 - Natural Field Installation
2. 32 18 23.28 – Natural Field Root Zone

1.3 QUALITY CONTROL

A. The Turf Contractor shall use an independent testing laboratory selected by the Owner to provide testing of selected sod. Test on sod shall be made prior to harvesting and prior to installation of delivered sod.

B. Approved Testing Laboratory.
1. Thomas Turf Services, Inc.
Mr. Jim Thomas
1501 FM 2818, Suite 302
College Station, Texas 77840-5247
Phone 409/764-2152

1.4 SUBMITTALS

A. Submit certified sample of Tifway 419 for testing by Owner's testing agent. Sample shall be one foot square with 1" of soil below the thatch layer.

B. Submit Certificates of Inspection as required by Government agencies for the sod.

1.5 DELIVERY, STORAGE AND HANDLING

A. Sod shall be delivered in netted rolls. Sod shall be temporarily stored in clean area by Turf Contractor to prevent contamination of sod. Turf Contractor shall handle sod so as to not tear
turf or displace soil from root system.

PART 2 PRODUCTS

2.1 MATERIALS

A. Playing Fields.
1. The sod shall be a Nursery grown sand based Certified Tifway 419 Sod. The sand based soil shall have a minimum of 80% sand and a maximum of 10% clay as defined by the U.S.D.A. soil classification system as provided by Turf Grass America, 4600 FM 2504, Poteet, Texas.
2. The sod soil at the growing site shall be tested for the presence of phytopatho genic nematodes by an approved Laboratory. Evidence of such test taken not more than 3 months prior to harvest shall be furnished to the Owner and evaluated for suitability. The sod shall be free of insects, broad leaf weeds, and objectionable grasses.

3. The turf shall be strongly-rooted sod (not sprigs), that has been in a mature condition of growth in the field no less than ten (10) months prior to harvest. Turf grass shall be of a vigorous growth and development.
4. The turf shall be maintained at a mowed height of 1" going from the Summer season to the Fall. The final mowing prior to harvest shall be at a height of 3/4" prior to installation.
5. The turf grass crop must be mature by April and will be subject to inspection by Owner from March through July for verification of this condition.
6. The sod will be machine stripped at a uniform thickness of 3/4" below the thatch line. The sod shall be rolled into big rolls of 42" wide and 50' long. The rolls shall be netted. The sod shall be harvested not more than 18 to 24 hours prior to installation.
7. Owner shall have sole discretion to accept or reject delivered sod.
8. Any delivered sod once accepted by Owner that becomes damaged or unsuitable for installation as determined by Owner shall be replaced by Turf Contractor at no expense to Owner.

B. Select Areas.
1. Sod for select areas shall meet the same requirements as for the playing fields as stated above under Paragraph 2.1.a.

END OF SECTION

SECTION 32 18 23.27
NATURAL FIELD INSTALLATION

PART 1 GENERAL

1.1 SCOPE

A. Work in this section consists of installing certified and approved “big roll” turf on approved root zone materials for playing fields and select areas.

1.2 RELATED WORK

A. Division 32 – Exterior Improvements
1. 32 80 00 - Irrigation
2. 32 18 23.26 - Natural Field Sport Surfacing.
3. 32 18 23.28 – Natural Field Root Zone

1.3 QUALITY CONTROL

A. Turf Contractor shall verify the root zone materials are to proper grade and thickness before proceeding with the installation of turf.

B. The installation of the natural grass field shall be made under the direct, active, personal supervision of at least three technical representatives who are employees of the natural grass Contractor/Installer. The natural grass Contractor/Installer shall have installed a minimum of ten (10) full size outdoor natural grass fields meeting NCAA field requirements. The school shall review and approve the installation crew prior to beginning work on the field.

PART 2 PRODUCTS

2.1 MATERIALS

A. The turf to be installed shall meet the requirements of SECTION 32 18 23.26.

B. Fertilizer to be added to the root zone mix shall be as recommended by the Owner’s approved testing laboratory.

C. All fertilizer shall be of uniform composition and suitable for application by a mechanical spreader.

D. Fertilizers shall be delivered in bags. Each bag shall be labeled according to State of Texas fertilizer laws.

E. Each bag of fertilizer shall have the following label information:

1. Name brand.
2. Name and address of manufacturer.
3. Net pounds of fertilizer.
4. Chemical composition.
5. Guarantee of composition.

PART 3 EXECUTION

3.1 GENERAL

A. Turf Contractor shall coordinate the turf installation with other Contractors working at the project site.

3.2 SITE PREPARATION

A. Turf Contractor shall verify the imported topsoil for the playing fields and select areas are to plan elevations, thickness and meets testing laboratory recommendations.

B. Turf Contractor shall submit a certificate to the Owner's Representative prior to adding fertilizer and turf stating the imported topsoil for the playing fields and select areas are to plan elevations and the imported topsoil complies with the testing laboratory recommendations.

C. Owner's Representative will review the finish grade of the topsoil and will provide written approval of the work. Turf Contractor will not proceed with the turf installation without the written approval.

3.3 ROOT ZONE FERTILIZER

A. After the root zone has been approved as to grade and thickness Turf Contractor shall install a fertilizer in the upper 2 to 3 inches of the root zone.

B. Fertilizer to be installed shall meet the chemical analysis as recommended by the testing laboratory conducting fertility test on the root zone mix.

C. Dry fertilizer shall be applied just prior to the installation of turf.

D. Turf Contractor shall regrade the root zone mix to finished grade and shall keep the root zone moist until the turf is installed.

3.4 TURF INSTALLATION

A. Sod for the playing fields and select areas shall be big roll sod, 42 inches in width and 50 feet long. Sod shall be layed in a north-south direction. The sod shall be placed within 24 hours from the time the sod was harvested. Sod not placed within 24 hours of harvesting will be rejected by the Owner's Representative. Cost to replace rejected sod will be borne by the Turf Contractor.

B. Sod shall be placed on a moist root zone mix. The sod shall be laid in straight lines with the first roll being the guide for subsequent rolls. Each roll shall be placed parallel to and snug against the preceding roll. <u>All sod netting shall be removed as the roll of sod is being installed.</u>

C. Rolls of sod shall be laid so as to stagger the ends of each roll with that of the adjoining roll of turf. Do not stretch rolls of sod. End joints of sod shall be cut square.

D. Turf Contractor shall use equipment designed to install rolled turf. The machines shall have high flotation tires to minimize disturbance of the root zone surface. Heavy equipment will not be allowed on the root zone material. Any area of the root zone material that is disturbed shall be hand raked by the Turf Contractor back to finished grade.

E. Turf Contractor shall not allow turf installing equipment to operate on newly installed sod. Turf Contractor shall fill all cracks between seams. Seams of sod shall be filled by hand using root zone mix material. Turf Contractor shall hand tamp or roll sod to remove air pockets and insure sod is in contact with the root zone material.

F. Owner's Representative will inspect the installed sod and shall note any defects. Defects shall be repaired or replaced by the Turf Contractor. Repair patches shall be a minimum of 42 inches by 42 inches in size. All edges shall be square cut. Seams shall be filled in with root zone material. Patches shall be hand tamped after installation.

G. Placed sod shall be watered immediately after placement. Water sufficiently to moisten the root zone material a depth of 1 to 2 inches.

H. Owner's Representative will inspect the installed turf at the end of each days installation. Unacceptable turf shall be removed immediately and replaced with fresh turf from the next days installation. Owner's Representative shall have sole judgment as to determining unacceptable sod, and repair areas of the installed sod.

3.5 ROLLING

A. After all the sod is in place, Turf Contractor shall roll the sod with a mechanical roller weighing 2.5-4 tons. Sod shall be rolled in two directions perpendicular to each other. Rolling shall provide a uniform even surface with no visible high or low areas.

3.6 WATERING

A. The irrigation system shall be checked daily during sod installation to insure lines, valves and heads are not damaged and the system does not leak. Heads shall be adjusted to proper elevation and shall be cleaned to assure proper pop-up operation.

B. After rolling operations are complete, sod shall be watered sufficiently to wet the sod and root zone material.

C. Watering during the grow-in and maintenance period shall be daily. During the first two weeks the sod shall be watered at least three times a day. The times shall be evenly spaced between sun up and two hours before sun set. When the sod has established at least 2 to 3 inches of root system into the root zone material, the watering may be reduced to two waterings during the day. Application of water shall be at a rate of 1/4 inch per application.

3.7 GROW-IN AND MAINTENANCE PERIOD

A. The grow-in and maintenance period for the installed turf shall begin when all the project sod is in place and shall continue for 90 days.

B. Turf Contractor shall be responsible for watering, mowing, applying fertilizer, herbicides, pesticides and replacing defective sod.

C. Turf Contractor shall start mowing operations when the turf leaf blades are 1 inch high. Turf shall be cut to a height of 7/8 inch during the grow-in period. Mowing shall be on a daily basis with no more than 1/3 of the leaf blade removed at one time.

PART 4 PROJECT ACCEPTANCE

4.1 Substantial Completion:

A. At the end of the grow-in and maintenance period, Turf Contractor shall request in writing an inspection by the Owner and his representatives. Written Notice shall be given 3 days before the date of inspection.

B. The joint inspection shall be made to note any sod area that is deficient according to the project plans and specifications. The Owner or his representatives shall have sole responsibility in determining work that must done prior to final acceptance of the work.

C. To be considered substantially complete, the inspection will be based on the following criteria:

1. The root depth for the sod must be at least 3 1/2” inches based on 10 random cores of the turfed area.

2. The turf must be green, dense and void of any dead areas and weeds over the entire sodded area.

3. The turf must be smooth and level.

4. The turf is cut to a height of 9/16 inch.

5. The soil and sod must be within allowable parameters as determined by the Owner’s testing laboratory.

4.2 Final Acceptance

A. The Turf Contractor shall notify the Owner in writing 3 days in advance of when the Turf Contractor anticipates the final inspection.

B. Owner and his representatives shall review the project to determine that all defective items noted in the substantial completion have been corrected and the finished project complies with the project plans and specifications.

C. Turf Contractor shall prepare a 90-day development program with suggested mowing, watering and fertilizing schedules.

D. The Owner will issue final acceptance for the turf installation.

END OF SECTION

SECTION 32 18 23.28
NATURAL FIELD ROOT ZONE

PART 1 GENERAL

1.1 SCOPE

A. Work in this section consists of furnishing and installing a root zone mix to support the growth of playing field sod.

1.2 RELATED WORK

A. Division 32 – Exterior Improvements

1. 32 80 00 - Irrigation
2. 32 18 23.26 - Natural Field Sport Surfacing
3. 32 18 23.27 - Natural Field Installation.

1.3 QUALITY CONTROL

A. The Turf Contractor shall use an independent testing laboratory selected by the Owner to provide testing of selected sand to used in the root zone.

B. Approved Testing Laboratory.

1. Thomas Turf Services, Inc.
Mr. Jim Thomas
1501 FM 2818, Suite 302
College Station, Texas 77840-5247
Phone 409/764-2152

1.4 SUBMITTALS

A. Submit at a minimum, a 2 gallon container of sand and a 2 gallon container of loam to be tested. Additional material shall be submitted if so requested by the Testing Laboratory in order to complete their test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Root Zone Sand. - Root zone sand material shall be a washed processed sand free from organic and foreign material. Sand from soft origin shall not be used. Sand shall conform to the following analysis:

1. Particle Size.

Size	Sieve Mesh	Particle Diameter mm	Recommendation (By Weight)
Gravel	10	2.0 - 3.4	Not more than 10% of the total particles in this range, including a maximum of 3% fine gravel
Very Coarse	18	1.0 - 2.0	

Sand			(preferably none)
Coarse Sand	35	0.5 - 1.0	Minimum of 60% of the particles must fall within this range.
Medium	60	0.25 - 0.5	
Fine Sand	100	0.15 - 0.25	Not more than 20% of the particles may fall within this range
Very Fine Sand	270	0.05 - 0.15	Not more than 5% Total Particles in this range
Silt		0.002-0.05	Not more than 5% shall not exceed 10%
Clay		Less than 0.002	Not more than 5%

2. The physical properties of the sand shall meet the following criteria:

Physical Properties	Recommend Range
Total Porosity	35-55%
Air Filled Porosity (@ 40cm tension)	15-30%
Capillary Porosity (@ 40cm tension)	15-25%
Saturated Conductivity	9-18 inches/hr.
Organic Matter Content (by weight)	1-5% (ideally 2-4%)

B. Root Zone Soil. - Root zone soil material shall be a sandy loam consisting of the following analysis:

1. Textural Analysis:

Size	Sieve Diameter (mm)	Recommendation (By Weight)
Sand	0.05 to 2.0	Min. 65% to 80%
Silt	0.02 to 0.05	Remainder w/
Clay	below 0.002	Min. 17%

2. Sand Distribution:

Size	Sieve No.	Percent Retained
Gravel	10	3% Max.
Very Coarse Sand	18	10% Max.
Coarse Sand	35	
Medium Sand	60	Remainder of
Fine Sand	100	Combined Percentages
Very Fine Sand	270	

3. pH valve between 5.5 and 6.5

4. Maximum liquid limit of 50

Root Zone Mixture. - The root zone mixture shall consist of approximately 60% sand and 40% loam soil measured by volume of materials. The mixture of sand and loam soil shall be blended by pug mill or an

approved alternate soil blender or method. The exact amounts of sand and organic material will be determined by testing of available material.

C. Fertilizer. - The root zone mixture of sand and loam soil will be tested for fertility. The testing laboratory will recommend a complete fertilizer program for the grow-in period for the sod.

PART 3 EXECUTION

3.1 DELIVERY OF ROOT ZONE MIX

A. The root zone mix is to be delivered in clean covered trucks. The material cannot be stored at the site except in an emergency. If storage is necessary, the material shall be placed on a clean hard surface with good drainage and away from waste materials. It is important that this material not be contaminated with foreign substances.

B. Owner's Representative shall observe each load of root zone mix. If irregularities are observed, samples shall be taken for test. Until subsequent test show the material to be acceptable, all deliveries of the material will stop.

3.2 PLACEMENT OF ROOT ZONE MIX

A. Turf Contractor shall verify the grade and contour of the subgrade to receive the root zone mix. The subgrade shall be smooth graded so as to receive a uniform thickness of 6 inches of root zone material. Turf Contractor shall verify irrigation is adequately in place and functioning. The subgrade shall be treated with a herbicide following manufacturer's recommendation prior to placement of the root zone mix.

B. The root zone mix shall be placed on the subgrade in such a manner as to minimize movement of equipment on the root zone material. A track mounted tractor shall be used to uniformly spread and rough grade the soil to ± 1/2" of plan elevations.

C. Upon completion of installing the root zone mix, the Turf Contractor shall operate the irrigation system one complete cycle. Fill all low spots with root zone material and water in. This process shall be repeated until all low areas are detected and corrected. Finish surface grades shall be verified using laser operated survey instruments. Do not roll the soil. Field compaction shall not exceed bulk density as determined by laboratory test.

3.3 FINE GRADING

A. The Turf Contractor shall fine grade the root zone mixture using laser operated instruments and equipment. Hand rakes shall be used to remove windrows, ruts or other variations in the surface of the root zone mix. Surface elevation shall be ± 1/4" measured horizontally between 25' x 25' grids.

B. The Turf Contractor shall maintain the root zone mix to plan elevations until sod operations begin.

C. Owner's Representative will solely determine the acceptability of the fine graded root zone area for the placement of sod. Areas to receive sod shall be firm and the drainage and irrigation system operational.

END OF SECTION

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide chain link fencing in heights and at locations / configurations as indicated on the Drawings.
   02 Provide single and double chain link gates where indicated on the Drawings.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 32 13 13 – Concrete Paving
   03 Section 32 31 26 – Traffic Gates and Operators

1.2 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.

D. Site Plan Drawings:
   01 Site plan (and more detailed plan where necessary) showing layout of all proposed chain link fencing and gates.
   02 Indicate height, size, material, and finish.
   03 Include details of post anchoring / footings, joints, attachments and clearances of all components.

E. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.

02 Generic details that do not depict actual conditions shall not be acceptable.

F. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

G. Color / Finish Samples:
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

1.3 REFERENCES

A. American Society for Testing Materials:
01 ASTM A90 – Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
02 ASTM A153 / A153M-16 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
03 ASTM A510 / A510M-20 – Standard Specification for General Requirements for Wire Rods and Course Round Wire, Carbon Steel, and Alloy Steel.
04 ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
05 ASTM A924 / A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
06 ASTM F668 – Polyvinyl Chloride (PVC)-Coated Steel Chain Link Fence Fabric
07 ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
08 ASTM F1043 - Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
09 ASTM F1664 - Standard Specification for Polyvinyl Chloride (PVC)-Coated Steel Tension Wire Used with Chain Link-Fence.

B. Chain Link Fence Manufacturers Institute "Industrial Steel Specifications for Fence Posts, Gates and Accessories".

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain Link Fabric: (PVC Coated)
01 Diamond mesh (2 inch), helically-woven and inter-woven.
02 Class 2A – Extruded and bonded.
03 Wire Size: Minimum 9-gauge copper bearing steel wire, hot dip galvanized. Gauge does not include PVC coating.
04 Wire Tensile Strength: 70,000 PSI.

05 Twisted and barbed (double knuckle) finished at top and bottom selvages (no exposed barbs).
06 Attach chain link fabric with black 9-gauge galvanized tie wire to all rails at 18” O.C. maximum intervals.

B. Framing:
01 All pipe components shall be fabricated from Schedule 40 steel pipe; unless noted otherwise.
02 All components shall be hot dip galvanized.
03 All rails shall be located toward the inside of the site.

C. Fence Posts:
01 Posts for fences 7’-0” or less:
a. Line: 2-1/2” O.D.
b. Terminal / End / Corner: 3” O.D.
02 Posts for fences 7’-1” to 10’-0”:
a. Line: 2-7/8” O.D.
b. Terminal / End / Corner: 3-1/2” O.D.
03 Line posts for fences 10’-1” or greater:
a. Line: 2-7/8” O.D.
b. Terminal / End / Corner: 4” O.D.
04 Provide conical tops at all posts, firmly secured in place.

D. Top and Bottom Rail:
01 Continuous top rail: 1-5/8” O.D. minimum.
02 Continuous bottom rail: 1-5/8” O.D. minimum. Provide at all fences 6’-0” or taller.
03 At fences without bottom rail, stretch minimum 9-gauge bottom tension wire taut between terminal posts. Securely anchor to each intermediate post 6 inches above grade and secure to fence fabric with hog rings at 24” O.C.

E. Mid Rails and Truss Braces:
01 Continuous mid rail: 1-5/8” O.D. minimum. Provide at all fences 8’-0” tall or taller.
02 Provide 5/16” truss rod and turnbuckle between terminal posts and adjacent posts.
03 Where required for stability and rigidity, provide 1-5/8” O.D. diagonal truss members between terminal posts and line posts.

F. Tension Bars and Wire:
01 Tension bars shall be minimum 5/8” flat bar. Connect chain link fabric to terminal posts with tension bands; 12” O.C. maximum spacing.

G. Swing Gates - ASTM F900:
01 General: Gate frames shall be constructed of 2” round steel tubing of the sizes listed below.
02 Person swing gates shall be joined at the corners by arc welding to form a rigid, one-piece unit and filled with specified chain link fabric to match the fence. Hot-dip galvanize after fabrication.
03 Fasten fabric to the frame on all four sides by means of adjustable hook bolts and tension rods. Equip all gates with galvanized steel hinges and latch.

04 Gate leaf width 3’-0” to 5’-0”: 2-1/4” O.D. 4.1 PLF, ASTM A120, galvanized schedule 50 pipe or 2-1/2 inch X 2-1/2 inch roll section, ASTM A501, hot dipped galvanized.

05 Gate leaf width 8’-0” to 11’-0”: 4” O.D. 9.11 pounds per foot, ASTM A120, galvanized schedule 50 pipe or 3” x 3” roll section, ASTM A501.

06 At double leaf gates, provide a crane bolt drop rod to secure one leaf. Provide a receiver in ground for drop rod. Imbed received in concrete minimum of 6" diameter by 12" deep. Provide a clip to secure the drop rod in the raised position when the leaf is open.

H. Swing Gate Hardware:

01 Hinges: Provide male / female post type hinges.

a. Two (2) per gate up to 72”.

b. Three (3) hinges per gate 72” (+).

c. Where designated, provide self-closing spring hinge(s).

02 Standard Latches: Fork type latch capable of accepting (owner furnished) pad lock.

03 Self-Closing Gate Latches: Provide self-latching latch capable of accepting (owner furnished) pad lock.

04 Double Leaf Gate Latches: Provide 2-piece, heavy duty double-fork latch with 6” legs and slotted receiver; capable of accepting (owner furnished) pad lock.

05 Crane Bolts / Drop Rods: At double leaf gates, provide a crane bolt drop rod to secure one leaf.

a. Provide a receiver in ground for drop rod. Imbed receiver in concrete minimum of 6" diameter by 12" deep.

b. Provide a clip to secure the drop rod in the raised position when the leaf is open.

I. Swing Gates with Exit Devices:

01 Coordinate with hardware supplier for exact requirements of gate components for proper interface with exit device.

02 Self-closing hinges capable of latching exit device.

03 Exit Device Housing: Provide minimum 6”H x 2-1/2” D x 1/4” steel plate C-shape section welded continuous to gate frame at each end.

04 Strike Plate: Provide minimum 1/4" thick steel plate on fixed fence section as required to mount exit device strike receiver mechanism.

05 Within 36” of exit device on gate and adjacent fencing, provide 12 gauge, expanded, galvanized steel or similar means to preclude reaching through fence and activating the exit device.

06 Provide 12” high x 2” deep x 3/16” thick panic/kick tube. Tube to be width of gate. Weld tube to each side of gate.

07 All components to be hot-dipped galvanized. Touch up galvanized finish with specified paint as required.

08 Coordinate horizontal intermediate chain link rail support (if required) with location of hardware and mounting plate.

J. Polyvinyl Chloride (PVC) Coating:

01 Chain link fabric and associated wiring to be Class 2a PVC, 22 mil coating per ASTM F668 and ASTM F1664.

02 Rails, posts and other non-wire components shall have a bonded PVC coating to give equivalent performance to chain link fabric, per ASTM F1043.

03 All non-fabric components shall be finished with a minimum of 2 mils of epoxy paint per manufacturer’s standards.

04 Color: Black

PART 3 - EXECUTION

3.1 INSTALLATION

A. Spacing:
   01 Space line posts at 8'-0" O.C. maximum.
   02 Space pull posts where grade changes more than 30-degree slope.

B. Footings:
   01 Line Posts: Set in minimum 12” diameter concrete footing a minimum of 24” post embedment in concrete, with a minimum 3” concrete cover at the bottom.
   02 All terminal, corner, and pull posts: Set in minimum 12” diameter concrete footing a minimum of 36” inch post embedment in concrete, with a minimum 3” concrete cover at the bottom.
   03 Concrete footing sizes and depths are based on holding top of footings +/- 4” below finish grade. Concrete exposed at finish grade shall not be accepted.
   04 All concrete shall be 3,000 psi minimum (28 days), pea gravel aggregate.
   05 Refer to Section 03 30 00 – Cast-In-Place Concrete for additional information and requirements.

C. Install all chain link fencing and gates in strict accordance with Chain Link Manufacturers Institute recommendations.
   01 Stretch fabric to proper tension between terminal posts and securely fasten to frame. Bottom of fabric shall be held as uniformly as practical to the finished grade.
   02 Fasten chain link fabric securely to terminal posts with 3/16” x 3/4” tension bars and 11-gauge tie wires, spacing not to exceed 14 inches apart.
   03 Tie fabric to rails with 9-gauge tie wires, spacing not to exceed 18” O.C.

D. Gates (Swing): Install plumb and level. Adjust hardware for smooth operation.

END OF SECTION

SECTION 32 31 26

TRAFFIC GATES

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide chain link fence traffic gates in heights and at locations / configurations as indicated on the Drawings.

C. Related Work:
   01 Section 03 30 00 – Cast-In-Place Concrete
   02 Section 32 13 13 – Concrete Paving
   03 Section 32 13 13 – Chain Link Fencing and Gates

1.2 SUBMITTALS

A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Site Plan Drawings:
   01 Site plan (and more detailed plan where necessary) showing layout of all proposed traffic gates.
   02 Indicate height, size, material, and finish.
   03 Include details of post anchoring / footings, joints, attachments and clearances of all components.

D. Shop Drawings: Submit complete shop drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show profiles, sizes, spacing and locations of assembled components.
   02 Show details of shop fabrications, connections and details.
   03 Show details of field fabrications, connections and details.
   04 Provide calculations demonstrating compliance with wind load and other requirements.
   05 Shop drawings shall be sealed and signed by a Texas registered engineer.

E. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.

01 Installation details submitted for review shall be specific to the work of this contract and accurately depict interface within the assembly(s) indicated on the Drawings.
02 Generic details that do not depict actual conditions shall not be acceptable.

F. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
01 Include recommended cleaning products and instructions for use.
02 Where applicable, provide recommended maintenance schedules and procedures.

G. Color / Finish Samples
01 Provide two (2) samples of each finish for selection by the Architect.
02 Finish samples shall be provided of / on actual material; paper or digital samples shall not be accepted.
03 Minimum size shall be 3" x 3" but must be large enough to convey attributes of the proposed product.

H. Operations and Maintenance Manuals
01 Provide complete operations and maintenance manuals to the Owner.
02 Refer to section 01 78 23 – Operations and Maintenance Manuals
03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

I. For warranties longer than one (1) year, submit a sample of the warranty proposed to be furnished.

1.3 REFERENCES

A. American Society for Testing Materials:
01 ASTM A90 – Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
02 ASTM A153 / A153M-16 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
03 ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
04 ASTM A924 / A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
05 ASTM F668 – Polyvinyl Chloride (PVC)-Coated Steel Chain Link Fence Fabric.
06 ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
07 ASTM F1043 - Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
08 ASTM F1664 - Standard Specification for Polyvinyl Chloride (PVC)-Coated Steel Tension Wire Used with Chain Link-Fence.

B. "Industrial Steel Specifications for Fence Posts, Gates and Accessories" by Chain Link Fence Manufacturers Institute.

C. Underwriters Laboratory:

01 UL325
02 UL991

PART 2 - PRODUCTS

2.1 MATERIALS – CHAIN LINK FENCE TRAFFIC GATES

A. General:
- 01 Design of chain link fence traffic gates are based on a roller supported assembly with the gate supported by roller wheels on a “V” track.
- 02 Design shall be by the manufacturer as required for each location and opening width.
- 03 Traffic gates shall be complete assemblies, including supporting guide structure and accessories required for a smooth operating assembly.
- 04 Traffic gate shall be nominal 72” height.

B. Framing:
- 01 All pipe components shall be fabricated from Schedule 40 steel pipe; unless noted otherwise.
- 02 All components shall be hot dip galvanized.
- 03 All framing shall be located toward the inside / site side of the gate.
- 04 Traffic gates shall be fabricated from minimum 2” Schedule 40 pipe components with welded connections.
- 05 Framing design shall be a truss type design with verticals at 72” O.C. maximum with diagonal truss bracing within each frame / bay.
- 06 Roller support posts shall be minimum 4” Schedule 40 pipe embedded in minimum 18” x 48” concrete footing. Minimum of two (2) support posts.

C. Gate Rollers and Track:
- 01 Rollers at top of roller guide support structure shall be UHMW polyethylene rollers.
- 02 Gate shall be equipped with a minimum 6” diameter OHMW polyethylene V-groove, ball-bearing roller. Provide a minimum of two (2).
- 03 Track shall be 90 degree “V” shape galvanized steel track, flanged both sides for anchoring to concrete. Provide substantial anchors in concrete as required.
- 04 Gate track beyond opening shall be installed on a nominal 18” wide, continuous 4” concrete pad / slab, curbed both sides with 6” x 6” standard curbs.

D. Chain Link Fabric:
- 01 Diamond mesh (2 inch), helically-woven and inter-woven.
- 02 Class 2A – Extruded and bonded.
- 03 Wire Size: Minimum 9-gauge copper bearing steel wire, hot dip galvanized. Gauge does not include PVC coating.
- 04 Wire Tensile Strength: 70,000 PSI.
- 05 Twisted and barbed (double knuckle) finished at top and bottom selvages (no exposed barbs).
- 06 Attach chain link fabric with 9-gauge galvanized tie wire to all rails at 18” O.C. maximum intervals.

E. Tension Bars and Wire:
- 01 Tension bars shall be minimum 5/8” flat bar. Connect chain link fabric to terminal posts with tension bands; 12” O.C. maximum spacing.

F. Chain Link Fence Gate Finish:
   01 All chain link fabric shall be finished with a minimum of 22 mils of PVC coating, bonded to core wire.
   02 All non-fabric components shall be finished with a minimum of 2 mils of epoxy paint per manufacturer's standards.
   03 Color: Black.

PART 3 - EXECUTION

3.1 PREPARATION AND COORDINATION

A. Coordinate with Contractor and other trades for the installation of interfacing fencing work as required for the proper installation and operation of traffic gates.

B. Coordinate with Contractor and other trades for the installation of interfacing concrete work as required for the proper installation and operation of traffic gates.

3.2 INSTALLATION - GATES

A. Support structure posts footings shall be sized / designed by the gate manufacturer to be of sufficient size and depth for proper long-term operation of the gates.
   01 All posts shall be set a minimum of 36" below finish grade / concrete slab in a minimum 16" diameter concrete footing.
   02 Refer to Section 03 30 00 – Cast-In-Place Concrete for requirements of gate post footings.

B. Gate roller: 6" minimum wheels shall be bolted to the gate (between the wheel plates welded near the ends of the gate bottom rail).
   01 The gate shall be set upright with the V-grooved wheels positioned over the pre-installed steel V-track that traverses the gate opening.
   02 Roller guides shall be affixed to the gateposts at a height even with the gate top-rail to hold the gate in a vertical position.
   03 Gate stops shall be welded to the end of the gate or track so gate cannot pass rollers in either direction.

C. Install in strict accordance with manufacturer's standards and recommendations.

3.3 TESTING

A. Make necessary adjustments as required for proper function and operation.

END OF SECTION

SECTION 32 84 23

UNDERGROUND SPRINKLERS

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Provide a complete underground sprinkler irrigation system to serve code required planting. Irrigation contractor shall design, document, seal, and permit the irrigation system.
   02 Install all backflow preventers, vacuum breakers and valves required and / or shown on the Drawings.
   03 Coordinate with Electrical Contractor for power and connection to irrigation controllers.
   04 System shall be complete, including, but not limited to the following:
      a. Piping.
      b. Manual valves.
      c. Automatic control valves.
      d. Automatic drain valves.
      e. Sprinklers.
      f. Quick couplers.
      g. Controllers.
      h. Boxes for automatic control valves.

C. Related Work:
   01 Section 31 20 00 – Earth Moving
   02 Section 31 22 19 – Finish Grading
   03 Section 21 23 33 – Trenching and Backfill
   04 Section 32 92 00 – Sodding & Hydromulching
   05 Section 32 93 00 – Landscaping

1.2 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Intent of Drawings: Sprinkler lines shown on the Drawings are diagrammatic. Locations of all sprinkler heads, valves, piping, wiring, etc. shall be established by the Contractor at the time of construction. Sprinkler design an construction to meet the code requirements of the local jurisdiction.

C. Keep all areas of work clean, neat, and orderly at all times. Keep paved areas clean during installation operations.

1.3 SUBMITTALS

A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.

C. Complete Irrigation Design Drawings permits, materials, and installation shall be completed by a licensed irrigator and will be funded through the Irrigation contingency.

D. Irrigation Design drawings shall be calculated, drawn, and sealed by a licensed irrigator in the State of Texas and submitted to the local jurisdiction for Permit.to meet all local jurisdiction requirements.

E. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
   01 Show details of field fabrications, connections and details.
   02 Site plan drawing showing complete layout of underground sprinkler system, including all piping, heads (including type), valves, controllers, electrical wiring and connections.
   03 System shall be designed by a Licensed Irrigation Designer and all Shop Drawings shall be sealed and signed by the Licensed Designer.

F. Zoning Chart: Show each irrigation zone and its control valve.

G. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

H. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
   01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
   02 Generic details that do not depict actual conditions shall not be acceptable.

I. Maintenance Instructions: Submit manufacturer's complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
   01 Include recommended cleaning products and instructions for use.
   02 Where applicable, provide recommended maintenance schedules and procedures.

J. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

K. Operation and Maintenance (O&M) Manuals prior to Substantial Completion; required for Owner training and demonstrations:
   01 Irrigation controller.
   02 Valves and gate valves.
   03 Pipe and fittings.

04 Valve boxes.
05 Quick coupling valves.
06 Low voltage wire and connections.

L. Record Irrigation Drawings:
01 Furnish Record Drawings of complete irrigation system in accordance with the General and Special Conditions.
02 Procure full size set of Contract Drawings or electronic version of landscape plans from Architect.
03 Construction Drawings shall be on-site at all times while irrigation system is under construction.
04 Make daily record of all work installed each day either electronically or on the hard copy Drawing sheets or both.
05 Actual location of valves and quick couplers and all irrigation and drainage piping shall be shown on prints by dimensions from easily identifiable permanent features, such as buildings, curbs, fences, walks, or property lines.
06 Drawings shall show approved substitutions of material. Include material, manufacturer's name, and catalogue number.
07 Drawings shall be to scale and all indications shall be easily understandable, legible, and neat.

1.4 QUALITY ASSURANCE

A. Requirement of Regulatory Agencies:
01 All work and materials shall be in full accordance with the latest rules and regulations of safety orders of Division of Industrial Safety; the Uniform Plumbing Code, the TCEQ and other applicable laws or regulations, including those of the city in which construction is to take place.
02 Nothing in Drawings are to be construed to permit work not conforming to these codes. Should the Contract Documents be at variance with the aforementioned rules and regulations, notify Architect and get instructions before proceeding with the Work.

B. Testing:
01 Preliminary review of completed installation will be made by the Architect and TISD Maintenance prior to backfilling trenches and during hydrostatic testing.
02 Final review shall be made in conjunction with the groundcover, shrubs, and tree planting.

C. 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.

1.5 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Architect and Owner upon satisfactory completion of all Work.

B. Upon final acceptance, Owner will assume responsibility for maintenance of the Work. Said assumption does not relieve Contractor of obligations under Warranty.

1.6 WARRANTY

A. In addition to the manufacturer's guarantees or warrantees, all Work shall be warranted for one (1) year from the date of Final Acceptance against defects, material, equipment and workmanship by the Contractor. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defect in materials, equipment, and workmanship to the satisfaction of the Owner.

B. Contractor shall not be held responsible for failures due to neglect by the Owner, vandalism, etc., during the Warranty period. Report such conditions to the Architect in writing.

1.7 SYSTEM REQUIREMENTS

A. The underground sprinkler system shall be a complete system, including all piping, fittings, sprinkler heads, drip hoses, valves, controllers and wiring required for a complete operating system.

B. The underground sprinkler system shall accommodate 24/7/365 control of the irrigation zones and be designed to accommodate future expansion of the system.
   01 If none are indicated, provide system capable of individual control of up to twelve (12) separate zones.

C. All controllers and major components shall be commercial grade.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design of underground sprinklers is based on products manufactured by Hunter Industries.

B. Acceptable Manufacturers: The following manufacturers are acceptable to provide products of this Section, provide all proposed products meet or exceed the specified requirements. Approval must be by Owner
   01 Rainbird Corporation IQ Wireless

2.2 MATERIALS

A. Materials throughout the system shall be as specified and noted on the Drawings or within these Specifications, new and in perfect condition.

B. Gate Valves: Two inches (2”) in size and under, 125-pound bronze construction, non-rising stem type, sized to line. NIBCO #T113 or approved equal.

C. Sleeves: Control wire and water line sleeves shall be PVC 1120-1220, Schedule 40 pipe.
   01 Coordinate with Contractor and other trades as required for installation of all below pavement sleeves required for a complete installation; whether shown on the Drawings or not.

D. Irrigation Controllers: Hunter AD or equal approved by Owner

E. Control Wiring: While traditional system is preferred Wired option can be submitted for Owner Review. Wires shall be Solid copper, UL approved for direct burial in ground. Minimum gauge#14 UF (#12 UF for runs over 1,000 LF, Contractor shall measure to confirm). Common ground wire shall be white. Extra wires shall be run to the farthest valve location from the controller, one white and two yellow wires total, verify location with Architect.

F. Valve Boxes: Injection molded of polymers and fibrous inorganic temperature resistant components. Box shall provide adequate clearance to operate and service valve. Box and lid shall be black.

01 Acceptable Manufacturers: Amtek, Christy, Carson, or approved equal.

02 Valve boxes for remote control valves shall be rectangular, approximately 10-inch x 14-inch inside dimensions by 15 inches deep. Boxes shall be black with lockable lids and have painted on lid with 1-inch high white letters "RC".

03 Valve boxes for gate valves and quick couplers, shall be round, approximately 9-inch inside diameter by 10-inch deep. Boxes shall be green with lockable lids and have painted on lid with 1-inch high white letters "QC".

G. Sprinkler Heads: Heads must be selected (type: i.e., bubblier, 360, 180, etc.) and adjusted so that no water is sprayed directly onto astructure, fence or sidewalk, in a no-wind condition. Provide bubblers at all trees.

H. DBRY connections are needed for every connection.

I. Rain sensors must be incorporated into the system to preclude the system activating during periods of rainfall and to avoid inadvertent over-watering.

J. Conduit: All conduit for low voltage irrigation control wires shall be 2-inch Schedule 40 PVC. Control wiring may be placed in common sleeve with lateral or main lines under paving when sleeves are larger than 4-inches. Use galvanized steel pipe only under public roads or for high voltage power conductors.

2.3 PIPING

A. Piping on pressure and non-pressure side of irrigation control valves:

01 Two and one-half inch diameter and smaller – ASTM D1785, PVC 1120-1220 compound, Schedule 40.

02 Install a metallic strip, tape or tracer wire on all PVC or non- metallic underground main irrigation line piping to aid in locating pipe in future.

B. Identification: Continuously and permanently marked with manufacturer's name or trademark, size, schedule and type of pipe, working pressure at 73°F, and National Sanitation Foundation (NSF) approval.

2.4 FITTINGS

A. Fittings for Solvent- Welded Pipe:

01 Schedule 40, polyvinyl chloride, standard weight, as manufactured by "Sloane", "Lasco", or approved equal, to meet ASTM D2466-73 and D-2467-73.

02 Threaded PVC nipples - Schedule 80 PVC.

B. Fittings for Polyethylene Pipe:
   01 Polyallomer as manufactured by "Flintkote" or approved equal.
   02 Compression type of CPVC as manufactured by "Pepco".

C. Fittings for Swing Joints: **(Install at All Head locations)**
   01 Supply Schedule 40 "Marlex" elbows.
   02 Threaded PVC Nipples - Schedule 80 PVC.

2.5 PIPING JOINING MATERIALS

A. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656. Cristy's Red-Hot Glue with Primer of equal.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 METERING AND BACKFLOW PREVENTERS

A. Where a separate, dedicated meter is shown for the irrigation system(s), coordinate with Contractor and other trades as required for proper interface with irrigation system piping.

B. Coordinate with Contractor and other trades as required for proper interface of irrigation system with primary backflow preventer.

C. Verify all requirements and provide all required backflow preventers, vacuum breakers and similar devices required by authorities having jurisdiction (AHJ).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
   01 Contractor shall be acquainted with all site conditions. Should utilities or other work not shown on the Plans be found during excavations, Contractor shall promptly notify Architect for instructions as to further action. Failure to do so will make Contractor liable for any and all damage arising from operations subsequent to discovery of such utilities not shown on Plans.
   02 Contractor shall take necessary precautions to protect site conditions. Should damage be incurred, Contractor shall repair damage to its original condition or furnish and install an equal replacement.

3.2 LAYOUT

A. Consideration will not be given to design changes until after Award of Contract.

B. Lay out work as closely to that shown on the Contract Drawings as possible. Contract Drawings are diagrammatic in nature. Adjust layout as necessary to accommodate actual site conditions. Locate pipe and valves shown under paving in adjacent planting area.

C. Full and complete coverage is required. Contractor shall make minor adjustments to layout as required to assure full and complete coverage. When such adjustments require exceeding radius limitations shown on irrigation legend, contact Architect for direction.

D. Substitutions for smaller pipe sizes will be not be accepted.

3.3 EARTHWORK

A. Perform excavation as required for installation of work included under this Section, including shoring of earth banks if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to their original condition.

B. Should utilities not shown on the plans be found during excavation, promptly notify Architect for instructions as to further action. Failure to do so will make Contractor liable for any subsequent discovery of such utilities. Indicate such utility crossings on the Record Drawings promptly.

C. Dig trenches wide enough to allow a minimum of 4-inches between parallel pipe lines. Trenches shall be of sufficient depth for approved minimum cover from finish grade as follows:
   01 Over pipe on pressure side of irrigation control valve, control wires and quick coupling valves: 18 inches.
   02 Over pipe on non-pressure side of irrigation control valve: 12 inches.

D. Trenching within the drip-line of existing trees shall not employ the use of mechanical trenching devices. Hand dig without severing roots which exceed 1-1/2' in diameter. Notify the Architect immediately if site conditions prohibit such action.

3.4 PIPING INSTALLATION

A. General:
   01 Location and Arrangement: Drawings indicate approximate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
   02 Clean all pipes and fittings of dirt and moisture before assembly.
   03 Install piping free of sags and bends.
   04 Install groups of pipes parallel to each other, spaced to permit valve servicing.
   05 Install fittings for changes in direction and branch connections.
   06 Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
   07 Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.
   08 Install expansion loops in control-valve boxes for plastic piping.
   09 Lay piping on solid sub-base, uniformly sloped without humps or depressions.
   10 Install PVC piping in dry weather when temperature is above 40°F. Allow joints to cure at least 24 hours at temperatures above 40°F before testing.

B. Solvent-Welded Joints for PVC Pipes:

01 Use solvents and methods recommended or required by pipe manufacturer.
02 Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty-four (24) hours before placing the joint under water pressure.

C. Threaded Joints for Plastic Pipes:
01 Use Teflon tape on the threaded PVC fittings except where Marlex fittings are used.
02 Use strap-type friction wrench only. Do not use metal-jawed wrench.
03 When connection is plastic to metal, male adaptors shall be used. The male adaptor shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Teflon tape or approved equal.

D. Joints for Polyethylene Pipes:
01 Double-clamp all connections 1-1/4-inch diameter and greater.
02 Make all connections between polyethylene pipes and metal valves or pipes with threaded fittings using male adaptors.

E. Laying of Pipe:
01 Pipes shall be bedded in at least 2-inches of finely divided material with no rocks or clods over 1-inch diameter to provide a uniform bearing.
02 Pipe shall “snake” from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 feet of pipe is the minimum allowance for snaking. Or install plastic pipe in a manner to provide for expansion and contraction as recommended by the manufacturer.
03 Do not lay PVC pipe when there is water in the trench.
04 Cut plastic pipe with PVC pipe cutters or hacksaw to ensure a square cut. Remove burrs at cut ends prior to installation to ensure that a smooth unobstructed flow will be obtained and not clog the diaphragm of the valves.
05 All plastic to plastic joints shall be solvent-weld joints or slip seal joints. Only solvent recommended by the pipe manufacturer shall be used. Install plastic pipe and fittings as outlined and instructed by pipe manufacturer. It shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. Contractor shall assume full responsibility for the correct installation.

3.5 EQUIPMENT INSTALLATION

A. Gate Valves: Group valves together and locate in planted areas where possible. Box shall be flush with finish grade.

B. Irrigation Control Valves: Install control valves in valve boxes where shown and group together where practical. Place no closer than 12-inches to walk edges, buildings, and walls. Valve boxes shall be flush with finish grade.

C. Sprinkler Heads:
01 Place all rotary pop-up sprinkler heads in lawn area**s** on swing joints with top of heads 1-inch above finish grade. Place part-circle rotary pop-up sprinkler heads 8-inches from edge of and flush with top of adjacent walks, header boards, curbs, mowing bands, or paved areas at time of installation.

02 Install spray heads and bubbler heads on a swing joint assembly as required

D. Quick Coupling Valves: Install any required quick coupling valves on a swing joint assembly as detailed on the Drawings.

E. Automatic Controller:
01 Install per local code and manufacturer's latest printed instructions.
02 Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
03 Affix controller name (i.e. "Controller A") on inside of controller cabinet door with letters minimum of 1-inch high.
04 Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Seal irrigation diagram between two sheets of 20 mil (minimum) plastic.
05 Irrigation diagram shall be a reduced copy of the As-Built Drawing and shall show clearly all valves operated by the controller, showing station number, valve size, and the type of plants being irrigated.

F. Control Wiring:
01 Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lay to the side of pipe line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten (10') foot intervals.
02 Crimp and seal control wire splices at remote control valves with specified splicing materials. Line splices will be allowed only on runs of more than 500 feet. Line splices to be Scotchlok and sealed with Scotchkote sealer.
03 Install a minimum of two (2) extra control wires to the control valve located the greatest distance from the controller, one in both directions, (confirm location with Architect), and label each end blank or as shown on Drawings.

G. Closing of Pipe and Flushing of Lines:
01 Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
02 Thoroughly flush out all water lines before installing heads, valves and other hydrants.
03 Test as specified.
04 Upon completion of testing, complete assembly and adjust sprinkler heads for proper distribution.
05 All sprinkler heads and quick coupling valves shall be set perpendicular to finished grades unless otherwise designated on the Drawings, or otherwise specified.
a. Sprinkler heads adjacent to existing walls, curbs and other paved areas, shall be set to grade.
b. Sprinkler heads which are to be installed in lawn areas where the turf has not yet been established shall be set 1-inch above the proposed finish grade. Heads installed in this manner will be lowered to grade when the turf is sufficiently established to allow walking on it without appreciable destruction. Such lowering of heads shall be done by Contractor as part of the original contract with no additional cost to the Owner.

3.6 BACKFILL AND COMPACTING

A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil free of debris.

B. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 95 percent density under pavements, and 85 percent under planted areas. Backfill shall not be more than 50% complete before water is added (jetted) allowing all air pockets and settling to occur. Then the balance of the soil shall be added.

C. Compact trenches in areas to be planted by thoroughly flooding backfill. Jetting process may be used in those areas.

D. Dress off all areas to finish grades.

3.7 CLEAN UP

A. Clean up and remove all debris from the entire work area prior to Final Acceptance to satisfaction of Landscape Architect.

3.8 FIELD QUALITY CONTROL

A. Perform tests and/or call for inspections per local code requirements.

B. Perform hydrostatic tests when welded PVC joints have cured per manufacturer's instructions.
   - 01 Pressurized Mains:
     - a. Completely install mains, gate valves, and control valves. Do not install laterals.
     - b. Fill all lines with water.
     - c. Contact Architect:
       - 1) Contractor shall notify Architect 24 hours before pressure test is begun.
       - 2) Inform Architect of the results of the test the following day.
     - d. Pressurize the main with air to 70 psi. Monitor gauge for pressure loss for four (4) hours. Maximum allowable loss over four (24) hour period - 3 psi.
     - e. Leave lines and fittings exposed throughout testing period.
     - f. Leaks resulting from tests shall be repaired and tests repeated until the system passes.
     - g. Test all gate valves for leakage.
   - 02 Non-Pressure Laterals:
     - a. Test piping after laterals and risers are installed and system is fully operational.
     - b. Leave trenches open to detect possible leaks.

C. Submit written requests for inspections to the Architect at least forty-eight (48) hours prior to anticipated inspection date.

D. Systems Tests:
   - 01 Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

02 Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.

03 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Any irrigation product will be considered defective if it does not pass tests and inspections.

F. Prepare and submit test and inspection reports.

3.9 ADJUSTING

A. Adjust settings of all nozzles and controllers, minimizing overspray on walks and parking areas.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

END OF SECTION

SECTION 32 91 13.13

TOPSOIL PLACEMENT AND GRADING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for topsoil under this Section. Include payment in related Division 1 work.
2. Refer to Division 1 for unit price procedures.

PART 2 P R O D U C T S

2.1 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:

1. pH value of between 5.5 and 6.5
2. Liquid limit: 50 or less
3. Plasticity index: 20 or less
4. Gradation: maximum of 10 percent passing No. 200 sieve

B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.

C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Owner’s Representative.

B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.2 TOPSOIL EXCAVATION

A. Conform to excavation and stockpiling requirements of Division 31.

3.3 PLACEMENT

A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.

B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Division 31.

C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.

D. Remove spilled topsoil from curbs, gutters, and paved areas and dispose of excess topsoil in accordance with requirements of Division 1.

E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

3.4 PROTECTION

A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION 32 91 13.13

SECTION 32 92 13

HYDRO-MULCHING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Seeding, fertilizing, mulching, and maintenance in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for hydro mulch seeding is on an acre basis.
2. Refer to Division 1 for unit price procedures.
3. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit certification from supplier that each type of seed conforms to these specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.

C. Submit certificate stating that fertilizer complies with these specifications and requirements of Texas Fertilizer Law.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Topsoil: Conform to material requirements of Division 32.

B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet following requirements:

1. Rye: Fresh, clean, Italian rye grass seed (lollium multi-florum), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.
2. Bermuda: Extra-fancy, treated, lawn type common bermuda (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.
3. Wet, moldy, or otherwise damaged seed will not be accepted.
4. Seed requirements, application rates, and planting dates are:

TYPE	APPLICATION RATE POUNDS/A	PLANTING DATE
Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88	40 40	Jan 1 to Mar 31
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88 Annual Rye Grass (Gulf)	40 40 30	Oct 1 to Dec 31

C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of following elements:

1. Nitrogen: 10 Percent
2. Phosphoric Acid: 20 Percent
3. Potash: 10 Percent

D. Mulch:

1. Virgin wood cellulose fibers from whole wood chips having minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter.
2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
3. Dye mulch green for coverage verification purposes.

E. Soil Stabilizer: "Terra Tack 1" or approved equal.

F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Place and compact topsoil in accordance with requirements of Division 32.

B. Dispose of Objectionable and Waste Materials in accordance with Division 1.

3.2 APPLICATION

A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.

B. Fertilizer: Apply uniformly at rate of 500 pounds per acre.

C. Mulch: Apply uniformly at rate of 50 pounds per 1000 square feet.

D. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.

E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.

F. Sod: Lay single row of sod along perimeter where top soil and pavement intersect. Apply in conformance to Division 32.

G. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain Owner's Representative approval before resuming operations.

3.3 MAINTENANCE

A. Maintain grassed areas minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.

B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.

C. Repair areas damaged by erosion by regrading, rolling and replanting.

D. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydro mulch.

E. Mow grass when height reaches 3 1/2 inches or greater on average before final acceptance. Mow to height of 2 1/2 inches.

END OF SECTION 32 92 13

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SECTION 32 92 23

SODDING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod in areas other than designated athletic fields.

B. Planting of sod within areas designated on Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.

C. Sod is defined as blocks, squares, strips of turfgrass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.

D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for sodding is on square yard basis.
2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

A. Conform to requirements of Division 1.

1.4 QUALITY ASSURANCE

A. Sod only when weather and soil conditions are deemed by Owner's Representative to be suitable for proper placement.

B. Water and fertilize new sod.

C. Guarantee sod to be growing 30 days after substantial completion.

D. Maintenance Period:

1. Begin maintenance immediately after each section of grass sod is installed and continue for 30 day period from date of substantial completion.
2. Resod unacceptable areas.
3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

E. Notify Owner's Representative 10 days before end of maintenance period for inspection.

PART 2 P R O D U C T S

2.1 SOD

A. Species: Common Bermuda.

B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials.

C. Size: 12 inch wide strips, uniformly 2 inches thick with clean-cut edges.

D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

2.2 FERTILIZER

A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.3 WEED AND INSECT TREATMENT

A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to Owner’s Representative for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

2.4 WATER

A. Potable, available on-site through Contractor's water trucks. Contractor may use public water when water use is measured through Contractor's meter. Do not use private resident's water.

2.5 BANK SAND

A. Free of clay lumps, roots, grass, salt or other foreign material.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.

B. Top soil shall be free of weeds and foreign material immediately before sodding.

C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.

D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.

E. Spread 2 inch layer of bank sand over areas to be sodded prior to planting of sod.

F. Apply fertilizer at rate of 25 pounds per 1000 square feet. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.2 APPLICATION

A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within 24 hours of harvesting.

B. On slopes 2:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

C. Prior to placing sod, on slopes 3:1 or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into ground at maximum 16 feet on center along pitch of slope and equal to width of wire mesh horizontally across slopes.

D. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.

E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to Owner's Representative for approval, prior to construction.

3.3 MAINTENANCE

A. Watering:

1. Water lawn areas once a day with minimum 1/2 inch water for first 3 weeks after area is sodded.
2. After 3 week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.
3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.
4. Water in afternoon or at night to enable soil to absorb maximum amount of water with minimum evaporation.

B. Mowing:

1. Mow sod at intervals which will keep grass height from exceeding 3 1/2 inches.
2. Set mower blades at 2 1/2 inches.
3. Do not remove more than one-half of grass leaf surface.
4. Mow sodded areas requiring mowing within 1 month after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.
5. Remove grass clippings during or immediately after mowing.

C. Fertilizer and Pest Control:

1. Evenly spread fertilizer composite at rate of 40 pounds per 5000 square feet or as recommended by manufacturer. Do not place fertilizer until 2 weeks after placement of sod.
2. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss.
3. Apply mixture 1/4 to 1/2 inch thick.
4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

D. Restrict all traffic from sodded areas until sod is established or for minimum 10 days during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for minimum 30 days during growing season.

3.4 CLEANUP

A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass, and streets.

B. Remove barriers, signs, and other Contractor material and equipment from project site at termination of establishment period.

C. Dispose of unused materials and rubbish in accordance with Division 1.

END OF SECTION 32 92 23

SECTION 32 93 00

LANDSCAPING

CONDITIONS OF THE CONTRACT, TOMBALL ISD RFP, SECTIONS AA THROUGH CD AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Tomball ISD RFP #987-25 – Procurement and Contracting Requirements and Division 1 – General Requirements, including Section 01 25 00 – Request for Substitution Procedures.

B. Scope of Work:
   01 Procurement and installation of landscaping per documents and to comply with Landscape ordinances of Harris County and the City of Tomball.

C. Related Work:
   01 Section 31 22 19 - Finish Grading
   02 Section 32 13 13 – Concrete Paving and flatwork
   03 Section 32 84 23 Underground Sprinklers
   04 Section 32 92 00 Sodding & Hydro Mulching

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such Work and provide for all inspections and permits required by Federal, State and Local authorities in furnishing, transporting and installing materials.

B. Plants shall be subject to inspection and approval by Owner upon delivery for conformity to Specifications. Such approval shall not impair the right of inspection and rejection during progress of the Work.

C. Substitutions of plant materials will not be permitted unless authorized in writing by Owner.

D. The Contractor shall be solely responsible for the safe transportation of plants to the site, and for the condition of each plant upon arrival. Trees damaged, dehydrated, or abused during transit and storage will be rejected.

E. The Owner may inspect any phase of this operation and may reject any plant material improperly handled during any phase of this operation.

F. Furnish standard products in manufacturers' standard containers bearing original labels showing quantity, analysis and name of manufacturer.

G. Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product.

H. All planting beds to be properly prepared. All debris larger than three-quarter (3/4”) inch shall be removed prior to planting.

1.3 CONTRACTORS MAINTENANCE

A. The Contractor's maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing guys, resetting plants to proper grades or upright position, restoring the planting saucer and furnishing and applying such sprays and invigorates necessary to keep plants free from insects and diseases, and in thriving condition and mowing of entire site until 90 Days following the date of Substantial Completion

B. Protect planting areas and individual plants at all times against damage of all kinds for the duration of Maintenance Period. Any plants damaged or injured, because sufficient protection was not provided, shall be treated or replaced by the Contractor, as directed by Owner, at no additional cost to the Owner.

C. See following maintenance frequency schedule.

MAINTENANCE FREQUENCY SCHEDULE

Mowing, Edging, Trimming, Litter Clean Up, and Irrigation Monitoring:

Month	Number of Visits Per Month
January	2
February	2
March	4 (Start up irrigation system)
April	4
May	5
June	4
July	5
August	5
September	5
October	3
November	2 (Shut down irrigation system)
December	2

01 Top Dress Fertilizer: Thirty (30) days after seeding and/or sodding.
02 Mulching, Weeding, Weed Control and Guying Adjustment: As required at each visit.
03 Reseeding and/or Resodding: As required upon notice.

1.4 FINAL ACCEPTANCE

A. Work under this section will be accepted by the Owner upon satisfactory completion of all work, including maintenance, but excluding replacement of plant material under the warranty period. Upon final acceptance, the Owner will assume responsibility for maintenance of the Work.

B. Plants: Plants shall be nursery grown in accordance with good horticultural practices under climatic conditions similar to those of the project for at least two (2) years. Unless specifically noted otherwise, all plants shall be exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and

appearance as to be superior in form, number of branches, compactness and symmetry.

C. Plants shall be sound, healthy and vigorous, well branched and densely foliaged when in leaf. They shall be free from disease, insect pests, eggs, or larvae and shall have healthy, well developed root systems. They shall be free from physical damage or adverse conditions that would prevent thriving growth.

D. Plants shall be true to species and variety and shall conform to measurements specified, except that plants larger than specified may be used. Use of such plants shall not increase Contract price.

E. When container stock is specified, it shall have grown in the container in which it is delivered for at least six (6) months, but not over two (2) years. Samples must prove that no rootbound conditions exist. No container plants that have cracked or broken balls of earth when taken from container shall be planted, except upon special approval by the Owner. Container stock shall not be pruned before delivery. Field grown plants recently transplanted into containers shall not be accepted.

F. Trees that have damaged or crooked leaders, or multiple leaders, unless specified, will be rejected. Trees with abrasions of the bark, sunscalds, disfiguring knots, or freshly cut limbs over 3/4 inches that have not completely calloused, will be rejected. All root balls shall be carefully scarified to allow roots to grow outside root ball wrap.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fertilizer:
   01 Trees: Agriform 20-10-5 formula 21-gram tablets.
   02 Plant Beds: Agriform 20-10-5 formula 21-gram tablets.

B. Staking Material: The Contractor shall use staking materials meeting the specifications, subject to the approval of the Owner. Suggested materials:
   01 Wire: new #12 gauge, pliable, galvanized.
   02 Hose: garden type of 2-ply reinforced rubber.

C. Pre-Emergent Weed Control in areas of Woody Ornamental Plants shall be Eptam or Eptam-5-G as manufactured by Greenlight Products Company, San Antonio, Texas 782117.

D. Root Stimulator: Hi-yield root stimulator 5-12-3 (manufacturer's recommendation).

E. Mulch shall be Shredded Pine Bark, the product of standard stripping of bark from pine trees for timber or pulp manufacturing. The mulch shall be free of debris and of particles over 1 inch in diameter, provided by LETCO or approved equal.

F. Peat Moss shall be a domestic product consisting of ninety-eight percent (98%) partially decomposed organic material of natural occurrence. It shall be clean and free of mineral matter. Peat shall have a minimum of 35% moisture content at the time of incorporation into the soil.

G. Water shall be furnished by the Owner after Substantial Completion. Hoses and other watering equipment shall be furnished by the Contractor.

H. Chemical Additives: If determined necessary by soil tests, ph shall be maintained at 6.5 to 7.5.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Layout plants in locations shown on Drawings. Stake location of each tree and outlines of shrub and ground cover beds.

B. Excavate 18 inches for all planting, as hereinafter specified.

C. Subsoil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.

D. Tree pits – See Plan Spec.

E. Notify the Owner in writing of all soil or drainage conditions the Contractor considers detrimental to growth of plant materials.

F. If rock, hardpan, underground construction work, tree roots or other obstructions are encountered in the excavation of plant pits and beds, alternate locations may be selected by the Owner. Where locations cannot be changed, submit cost required to remove obstructions to a depth of not less than 6 inches below the required pit or bed depth. Proceed with Work after approval.

G. Canned stock shall be removed carefully after cans have been cut on two sides with approved cutter. Do not use spade to cut cans. Do not lift or handle container plants by tops, stems or trunks at any time.

H. Do not bind or handle any plant with wire or rope at any time to avoid damage to bark or broken branches. Lift and handle plants only from bottom of ball.

I. At Contractor's option and expense, spray all evergreen or deciduous plant material in full leaf immediately before digging with anti-desiccant applying an adequate film over trunks, branches, twigs and foliage.

J. Fill tree pits and beds with soil mix to compacted depth to receive plant root ball so top of root ball is 2 inches above finished grade.

K. Scarify the walls and bottom of all tree pits and beds immediately prior to the placement of plant and backfill mix.

L. Evenly distribute agriform tablets in plant pits two-thirds, backfilled, at the rate of one tablet per ½-inch caliper or per 1 foot of height, whichever is less.

M. Smooth planted areas to conform to specified grades after full settlement has occurred. Contractors shall bear final responsibility for proper surface drainage

of planted areas. Any discrepancy in the Drawings or Specifications, obstructions on the site or prior work done by another party, which the Contractor feels precludes establishing proper drainage, shall be brought to the attention of the Owner in writing. Failure to issue such notification establishes full responsibility for landscape drainage upon the Landscape Contractor.

N. Form saucer with 3 inches high berm of plant mix around trees 24 inches wider than the ball diameter.

O. Water all plants immediately, again, after planting.

P. Apply pre-emergent weed control material in areas to receive mulch.

Q. Spread mulch in required area to the compacted depth of 2 inches.

R. Fill all shrubs and ground cover beds with plant mix to 2 inches above finished grade (compacted).

S. Planting:
   01 Excavate in planting mix for individual plant and install as required. Set plant plumb and brace rigidly in position until planting soil mix has been tamped solidly around the ball and roots.
   02 When tree pits and beds have been backfilled approximately two-thirds full, place Agriform tablets evenly distributed in plant pits according to the following schedule:
      a. 1 gallon equivalent - 1 tablet.
      b. 5 gallon equivalent - 2 tablets.
   03 Water thoroughly, saturating root ball, before installing remainder of the planting soil to top of pit; climate all air pockets. Top of root ball shall be 2 inches above finished grade.
   04 Smooth planting areas to conform to specified grades after full settlement has occurred. The Contractor shall bear final responsibility for proper surface drainage of planted areas.
   05 Water all plants immediately, again, after planting.
   06 Apply pre-emergent week control material over entire area to receive mulch.
   07 Mulch all shrub and ground cover beds with shredded bark 2 inches thick.

T. Surface Drainage of Planting Areas: The Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the Drawings or Specifications, obstructions on the site, or prior work done by another party, which Contractor feels precludes establishing proper drainage, shall be brought to the attention of the Owner, in writing, for correction or relief of said responsibility.

U. Prune containerized plants only at time of planting, according to standard horticulture practice, to preserve the natural character of the plant. Prune by removing entangled branching and by removing crotches. Avoid removing branch tips wherever possible.
   01 Remove all dead wood, suckers and broken or badly bruised branches. Use only clean, sharp tools.

V. Staking of trees shall be done by the Contractor, who is responsible for material remaining plumb and straight for all given conditions through the guarantee period.

01 Staking shall be completed immediately after planting. Plants shall stand plumb after staking.

02 Drive all stakes to a sufficient depth (2-foot min.), and with sufficient firmness to maintain position so that they will not pull out or be displaced by stresses from wind or other natural causes.

03 Encase wires in hose, to prevent direct contact with the bard, and place them around the trunk in a single loop.

W. Clean up all areas as required for complete and acceptable inspection.

01 Make written request for inspection after planting operations are completed.

02 Submit requests for inspections to the Owner at least two (2) days prior to anticipated inspection date.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Precast concrete manholes for sanitary sewers, storm sewers, and water lines.

B. Precast concrete sanitary sewer manholes with PVC liner where corrosion resistant manholes.

C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for normal depth manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Manhole depth is measured from top of cover to sewer invert. Air release manhole depth is measured from top of cover to inside base for air release or vacuum release manholes.
2. Payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 5 feet or less measured from top of cover to sewer invert.
3. Payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Sewer manhole depth is measured from top of cover to sewer invert.
4. No separate payment for internal or external manhole drops.
5. Payment for pile-supported concrete foundation used for unstable subgrade treatment for manhole base is on a unit price basis for each foundation installed.
6. Refer to the provisions of Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASME B 16.1 -Cast Iron Pipe Flanges and Flanged Fittings

B. ASTM A 307 -Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile

C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

D. ASTM C 270-Standard Specification for Mortar for Unit Masonry

E. ASTM C 443 -Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

F. ASTM C 478 -Standard Specification for Precast Reinforced Concrete Manhole Sections

G. ASTM C 923 -Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes

H. ASTM C 1107 -Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

I. ASTM D 698 -Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-Ib/fr')

J. ASTM D 2665 -Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

K. ASTM D 2996 -Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

L. ASTM D 2997 -Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe

M. AWWA C 213 -Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines

N. American Association of State Highway and Transportation Officials (AASHTO)

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturer's data and details of following items for approval:

1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
3. Frames, grates, rings, and covers
4. Materials to be used in fabricating drop connections
5. Materials to be used for pipe connections at manhole walls
6. Materials to be used for stubs and stub plugs, if required
7. Materials and procedures for corrosion-resistant liner and coatings, if required.
8. Plugs to be used for sanitary sewer hydrostatic testing
9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches

C. Seal submittal drawings by Professional Engineer registered in State of Texas.

PART 2 P R O D U C T S

2.1 PRECAST CONCRETE MANHOLES

A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination

to provide correct height with fewest joints. Design wall sections for depth and loading conditions in Paragraph 2.01 E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.

C. Provide tops to support HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.

D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Owner's Representative.

E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.

1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf
4. Intemalliquid pressure based on unit weight of 63 pcf
5. Dead load of manhole sections fully supported by transition and base slabs

F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:

1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
2. Wall loading conditions:
   a. Saturated soil pressure acting on empty manhole
   b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure
3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater

G. Provide joints between sections with o-ring gaskets conforming to ASTM C 443.

H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.

I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

2.2 CONCRETE

A. Conform to requirements of Division 32.

B. Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.

C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, as shown on Drawings, conforming to requirements of Division 31.

D. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.3 REINFORCING STEEL

A. Conform to requirements of Division 32.

2.4 MORTAR

A. Conform to requirements of City of Houston Standard Specifications Section 04061 – Mortar.

2.5 MISCELLANEOUS METALS

A. Provide cast-iron frames, rings, and covers conforming to requirements of Division 33.

2.6 DROP CONNECTIONS AND STUBS

A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.7 PIPE CONNECTIONS TO MANHOLE

A. Sanitary Sewers.

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:
   a. External clamps: Type 304 stainless steel
   b. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
   c. Internal, expandable clamps on corrosion-resistant manholes:
      1) Type 316 stainless steel, 11 gauge minimum
      2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213
2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equal.

B. Storm Sewer Connections:

1. Provide watertight connections in accordance with ASTM C 923.

C. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equal. See Drawings for placement of assembly in manhole sections.
2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power

sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

2.8 SEALANT MATERIALS

A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.

B. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.

C. Provide Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

2.9 CORROSION RESISTANT MANHOLE MATERIALS

A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on Drawings, provide one of following:

1. PVC liner for precast cylindrical manhole section, base sections, and cone sections in accordance with Division 33.
2. Precast base sections, as specified above, lined with PVC or equal and fiberglass manholes in accordance with Division 33.

2.10 BACKFILL MATERIALS

A. Conform to requirements of Division 31.

2.11 NON-SHRINK GROUT

A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.

B. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

2.12 VENT PIPES

A. Provide external vent pipes for manholes where indicated on Drawings.

B. Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.

C. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:

1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
2. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive
3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.

4. Coating: Provide approved 2-component, aliphatic polyurethane coating using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Color shall be selected by The Engineer from manufacturer's standard colors.

2.13 PROHIBITED MATERIALS

A. Do not use brick masonry for construction of manholes, including adjustment of manholes to grade unless approved by the Engineer. Use only specified materials listed above.

2.14 MANHOLE LADDER FOR WATERLINE MANHOLES

A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings.

1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.
3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.
4. Provide approved petroleum-based tape encapsulating bolts in access manhole.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Verify that lines and grades are correct.

B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treat as unstable subgrade.

C. Do not build manholes in ditches, swales, or drainage paths unless approved by the Engineer.

3.2 PLACEMENT

A. Install precast manholes to conform to locations and dimensions shown on Drawings.

B. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS

A. Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, cement stabilized sand, or concrete foundation slab. Compact cement-sand in accordance with requirements of Division 2.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify the Engineer for examination of subgrade to determine if subgrade has heaved upwards after being

excavated. When heaving has not occurred, over-excavate subgrade to allow for 24 inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

3.4 PRECAST MANHOLE SECTIONS

A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.

C. Seal any lifting holes with non-shrink grout.

D. Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.

E. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

3.5 PIPE CONNECTIONS AT MANHOLES

A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.

1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.
2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

B. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.

C. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.

D. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.

E. Test connection for watertight seal before backfilling.

3.6 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/ 2 inches per foot maximum
2. Depth of bench to invert:
   a. Pipes smaller than 15 inches: one-half of largest pipe diameter
   b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
   c. Pipes larger than 24 inches: equal to largest pipe diameter
3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.7 DROP CONNECTIONS FOR SANITARY SEWERS

A. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of four (4) inches outside bells.

B. Install drop connection when sewer line enters manhole higher than 30 inches above invert of manhole.

3.8 STUBS FOR FUTURE CONNECTIONS

A. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.9 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.

B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.

C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded comer around perimeter.

3.10 BACKFILL

A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Division 31. Provide embedment zone backfill material, as specified for adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to springline of pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32. When shown on Drawings, sod disturbed areas in accordance with Division 32.

3.11 FIELD QUALITY CONTROL

A. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Division 33.

3.12 PROTECTION

A. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to the Owner.

END OF SECTION 33 05 13

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SECTION 33 05 13.13

MANHOLES GRADE ADJUSTMENT

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Adjusting elevation of manholes, inlets, and valve boxes to new grades.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for adjusting inlets and valve boxes to grade for new construction under this Section. Include payment in unit price for related item.
2. Payment for adjusting existing manhole and frame and cover to new grade is on a unit price basis for each manhole and frame and cover.
3. Payment for adjusting existing utility structures to grade is on unit price basis for each:
   a. Inlet adjusted
   b. Valve box adjusted
   c. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

PART 2 P R O D U C T S

2.1 CONCRETE MATERIALS

A. Provide concrete, conforming to requirements of Division 33.

B. Provide precast concrete manhole sections and adjustment rings conforming to requirements of Division 33.

C. Provide mortar conforming to requirements of City of Houston Standard Specifications Section 04016 - Mortar.

2.2 CAST-IRON MATERIALS

A. Provide cast-iron materials conforming to requirements of Division 33.

2.3 PIPING MATERIALS

A. For riser pipes and fittings, refer to Division 33.

2.4 MASONRY MATERIALS FOR STORM SEWER MANHOLES AND INLETS

A. Provide brick masonry units conforming to the requirements of Division 32.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Project Manger.

3.2 ESTABLISHING GRADE

A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established benchmark or reference line.

3.3 ADJUSTING MANHOLES AND INLETS

A. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in Division 33.

B. Salvage and reuse cast-iron frame and cover or grate.

C. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.

D. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Project Manger's approval.

3.4 ADJUSTING VALVE BOXES

A. Salvage and reuse valve box and surrounding concrete block as approved by Project Manger. No separate pay.

B. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.

C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.

D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade.

3.5 BACKFILL AND GRADING

A. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Division 31.

B. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.

C. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32.

END OF SECTION 33 05 13.13

SECTION 33 05 16.13

PRECAST CONCRETE UTILITY STRUCTURES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Precast concrete inlets for storm or sanitary sewers, including cast iron frame and plate or grate.

B. Precast concrete headwalls and wingwalls for storm sewers.

C. Precast junction box with lid or grate top.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for inlets is on unit price basis for each inlet installed.
2. Payment for headwalls and wingwalls is on unit price basis for each headwall and wingwall installed.
3. Payment for junction box with lid or grate top is on unit price basis for each junction box installed.
4. Payment for inlets, headwalls, wingwalls, and junction boxes includes connection of lines and furnishing and installing frames, grates, rings, and covers.
5. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES .

A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit shop drawings for approval of design and construction details for precast concrete inlets, junction box headwalls, and wingwalls. Precast units differing from standard designs shown on Drawings will be rejected unless shop drawing submittals are approved. Clearly show proposed substitution is equal or superior in every aspect to standard designs.

C. Submit manufacturers' data and details for frames, grates, rings, and covers.

1.5 STORAGE AND SHIPMENT

A. Store precast units on level blocking. Do not place loads until design strength is reached. Shipment of acceptable units may be made when 28-day strength requirements have been met.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Concrete: Provide concrete for precast machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4,000 psi.

B. Reinforcing Steel: Place reinforcing steel to conform to details shown on Drawings and as follows:

1. Provide positive means for holding steel cages in place throughout production of concrete units. Maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch, whichever is less. Regardless of variation, maintain minimum cover of concrete over reinforcement as shown on Drawings.
2. Welding of reinforcing steel is not permitted unless noted on Drawings.

C. Mortar and Hydraulic Cement: Conform to requirements of Division 32.

D. Miscellaneous Metal: Cast-iron frames and plates conforming to requirements of Division 33.

2.2 SOURCE QUALITY CONTROL

A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on Drawings. Concrete thickness in excess of that required will not constitute cause for rejection provided that excess thickness does not interfere with proper jointing operations.

B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on inside of inlet, headwall, or wingwall.

C. Rejection: Precast units rejected for non-conformity with these specifications and for following reasons:

1. Fractures or cracks passing through shell, except for single end crack that does not exceed depth of joint.
2. Surface defects indicating honeycombed or open texture.
3. Damaged or misshaped ends, where damage would prevent making satisfactory joint.

D. Replacement: Immediately remove rejected units from Work site and replace with acceptable units.

E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in opinion of Owner's Representative, repaired units conform to requirements of these specifications.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Verify lines and grades are correct.

B. Verify compacted subgrade will support loads imposed by inlets.

3.2 INSTALLATION

A. Install units complete in place to dimensions, lines, and grades as shown on Drawings.

B. Excavate in accordance with requirements of Division 31.

C. Bed precast concrete units on foundations of firm, stable material shaped to conform to shape of unit bases.

D. Provide adequate means to lift and place concrete units.

3.3 FINISHES

A. Use hydraulic cement to seal joints, fill lifting holes and as otherwise required.

B. When box section of inlet has been completed, shape floor of inlet with mortar to conform to Drawing details.

C. Adjust cast iron inlet plate frames to line, grade, and slope shown on Drawings. Grout frame in place with mortar.

3.4 INLET WATERTIGHTNESS

A. Verify that inlets are free of leaks. Repair leaks in approved manner.

3.5 CONNECTIONS

A. Connect storm sewer leads to inlets as shown on Drawings. Seal connections inside and outside with hydraulic cement. Make connections watertight.

3.6 BACKFILL

A. Backfill area of excavation surrounding each completed inlet, headwall, or wingwall according to requirements of Division 31.

END OF SECTION 33 05 16.13

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SECTION 33 05 16.16

CONCRETE FOR UTILITY CONSTRUCTION

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No payment will be made for concrete for utility construction under this Section. Include cost in applicable utility structure.
2. Obtain services of and pay for certified testing laboratory to prepare design mixes.
3. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

E. ACI 308 - Standard Practice for Curing Concrete.

F. ACI 309R - Guide for Consolidation of Concrete.

G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.

H. ACI 315 - Details and Detailing of Concrete Reinforcement.

I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.

J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.

K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.

Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.

R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

S. ASTM C 33 - Standard Specification for Concrete Aggregates.

T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.

X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

Y. ASTM C 150 - Standard Specification for Portland Cement.

Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

FF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.

GG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

HH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

II. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.

JJ. CRSI MSP-1 - Manual of Standard Practice.

KK. CRSI - Placing Reinforcing Bars.
LL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

MM. NRMCA - Concrete Plant Standards.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit proposed mix design and test data for each type and strength of concrete in Work.

C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Owner’s Representative.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.5 HANDLING AND STORAGE

A. Cement: Store cement off of ground in well-ventilated, weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

PART 2 P R O D U C T S

2.1 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Owner’s Representative; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.
2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of Na2O + 0.658K20.

B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.

C. Aggregate:

1. Coarse Aggregate: ASTM C 33. Unless otherwise indicated, use following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.
2. Fine Aggregate: ASTM C 33.
3. Determine potential reactivity of fine and coarse aggregate in accordance with Appendix to ASTM C 33.

D. Air Entraining Admixtures: ASTM C 260.

E. Chemical Admixtures:

1. Water Reducers: ASTM C 494, Type A.
2. Water Reducing Retarders: ASTM 494, Type D.
3. High Range Water Reducers (Superplasticizers): ASTM C 494, Types F and G.

F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.

G. Reinforcing Steel:

1. Use new billet steel bars conforming to ASTM A 615, ASTM A 767, or ASTM A 775, grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.
2. Where shown, use welded wire fabric with wire conforming to ASTM A 185 or ASTM A 884. Supply gauge and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.
3. Wire: ASTM A 82. Use 16 1/2 gauge minimum for tie wire, unless otherwise indicated.

H. Fiber:

1. Fibrillated Polypropylene Fiber:
   a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.
   b. Physical Properties:
      1) Material: Polypropylene
      2) Length: 1/2 inch or graded
      3) Specific Gravity: 0.9l
   c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.
   a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
   b. Physical Properties:
      1) Material: Steel
      2) Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1
      3) Specific Gravity: 7.8
      4) Tensile Strength: 40-400 ksi.
      5) Young's Modulus: 29,000 ksi
      6) Minimum Average Tensile Strength: 50,000 psi

7) Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking

I. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

2.2 FORM WORK MATERIALS

A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.

C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.3 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.4 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.

B. Measure water and liquid admixtures by volume.

2.5 DESIGN MIX

A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Owner’s Representative for review.

C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Owner’s Representative.

D. Classification:

Class	Type	Minimum Compressive Strength (LBS/Sq.In.)		Miximum W/C Ratio	Air Content (Percent)	Consistency Range in Slump (Inches)
		7-Day	28-Day	0.45		
A	Structural	3200	4000		4 ± 1	2 to 4*
B	Pipe Block Fill, Thrust Block	---	1500	---	4 ± 1	5 to 7
*When ASTM C 494, Types F or Type G admixture is used to increase workability, this range may be 6 to 9.						

E. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.

F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.

G. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.6 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.

B. Flat Strip and Center-Bulb Waterstops:

1. Thickness: not less than 3/8 inch
2. Acceptable Manufacturers:
   a. Kirkhill Rubber Co., Brea, California
   b. Water Seals, Inc., Chicago, Illinois
   c. Progress Unlimited, Inc., New York, New York
   d. Greenstreak Plastic Products Co., St. Louis, Missouri
   e. Approved equal.

2.7 RESILIENT WATERSTOP

A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.

B. Bentonite Waterstop:

1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch

4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
2. Meets or exceeds requirements of Federal Specification SS-S-210A.
3. Supplied wrapped completely by 2 part protective paper.
4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.
5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.
6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko-Flex Products, Inc.; or approved equal.

PART 3 E X E C U T I O N

3.1 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back form work with sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by Owner's Representative, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

3.2 PLACING REINFORCEMENT

A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by Owner's Representative and obtain acceptance before concrete is placed.

B. Minimum spacing center-to-center of parallel bars: 2 1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.

C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.

D. Do not splice bars without written approval of Owner's Representative. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

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3.3 EMBEDDED ITEMS

A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.

B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.4 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 though 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Owner's Representative before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.

E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

G. Hand-mix only when approved by Owner’s Representative.

3.5 PLACING CONCRETE

A. Give sufficient advance notice to Owner’s Representative (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to Owner’s Representative's approval.

B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.

C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.

E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.6 WATERSTOPS

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

C. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.
2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.
3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Owner's Representative, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight-run portions of waterstop in forms.

D. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.

E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
2. When requested by Owner's Representative, provide technical assistance by manufacturer's representative in field at no additional cost to City.
3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.
5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.
6. Bentonite Waterstop:
    a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
    b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
    c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.
e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.

7. Adhesive Waterstop:
   a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.
   b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.
   c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.
   d. Do not remove protective paper until just before final form work completion. Place concrete immediately. time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.7 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Owner's Representative. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.
3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.8 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Owner's Representative.

B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Rubbed Finish:

1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Owner's Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.
2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

3.9 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.

B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Owner's Representative.

3.10 DEFECTIVE WORK

A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

3.11 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.

B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final

acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.

C. Apply wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

A. Testing shall be performed under provisions of Division 1.

B. Unless otherwise directed by Owner's Representative, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements of ASTM C 1077.

1. Take concrete samples in accordance with ASTM C 172.
2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.
3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.

C. Test Cores: Conform to ASTM C 42.

D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.

E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by Owner's Representative, at no additional cost to City.

3.13 PROTECTION

A. Protect concrete against damage until final acceptance by City.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Owner's Representative.

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SECTION 33 06 10.14

POLYVINYL CHLORIDE (PVC) PIPE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.

B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.

C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for PVC pipe under this Section. Include cost in unit price for work included as specified Division 2.
2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.

B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

F. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

G. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

H. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

I. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

K. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

L. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

N. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.

O. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.

P. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

Q. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.

R. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.

S. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.

T. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.

B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.

C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Owner’s Representative for review. Cost of testing paid by Contractor.

PART 2 P R O D U C T S

2.1 MATERIAL

A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.

B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.

1. Pipe Material:
   a. DR 18: For restrained joints where shown on Drawings.
   b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.

D. Water Service.

1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).

E. Gaskets:

1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

G. Do not use PVC in potentially or known contaminated areas.

H. Do not use PVC in areas exposed to direct sunlight.

2.2 WATER SERVICE PIPE

A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

B. Pipe 14 inch through 20 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.

C. Provide Polyvinyl Chloride Pipe from approved manufacturers.

D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Owner's Representative.

E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

2.3 GRAVITY SEWER PIPE

A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

Wall Construction	Manufacturer	ASTM Designation	SDR (Max.)/ Stiffness (Min.)	Diameter Size Range
Solid	J-M Pipe Certain Teed Diamond Uponor ETI North American	D3034	SDR 26 / PS 115	6" to 10"
		D3034	SDR 35 / PS 46	12" & 15"
		F679	SDR 35 / PS 46	18" to 27"
		AWWA C900	DR 18 / N/A	4" to 12"
		AWWA C909	DR 18 / N/A	4" to 12"
		AWWAC905	DR 18 / N/A	14" to 16"
Truss (Gasketed)	Contech	D2680	N/A / 200 psi	8" to 15"
Profile	Contech A-2000 Contech A-2026 ETI, Ultra-Rib ETI, Ultra-Corr	F949 F949 F794 F794	N/A / 46 psi N/A / 115 psi N/A / 46 psi N/A / 46 psi	12" to 36" 8" to 10" 8" to 30" 24" to 36"

B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.

C. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.

D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.

E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

F. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

G. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length.

H. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.

I. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.

J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.4 SANITARY SEWER FORCE MAIN PIPE

A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Division 33.

B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

C. Fittings: Provide approved ductile iron fittings as per Division 33, except furnish fittings with one of following approved internal linings:

1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
2. Nominal 40 mils (35 mils minimum) polyurethane
3. Nominal 40 mils (35 mils minimum) ceramic epoxy
4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy

D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Division 33.

E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 200 psi, may be provided for up to 12 inches in diameter (water or sanitary).

B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

PART 3 E X E C U T I O N

3.1 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer’s recommendations.

3.2 INSTALLATION

A. Conform to requirements of Division 33, as applicable.

B. Install PVC pipe in accordance with Division 33, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.

C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:

1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
2. Water service pipe 16 inches in diameter and larger 5 feet of cover.

D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.

E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.

F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.

G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

3.3 PVC RESTRAINED MECHANISM

A. Do not apply lubricant to spline or pipe or coupling spline grooves.

B. Do not use excessive force while inserting the spline through coupling.

C. Insert spline until it is fully seated around circumference of pipe.

D. Field Cutting of Pipe Ends:

1. Perform by workers certified by manufacturer.
2. Use a PVC pipe cutter and provide square ends.
3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION 33 06 10.14

SECTION 33 06 10.15

DUCTILE IRON PIPE AND FITTINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Ductile iron pipe and fittings for water mains, wastewater force mains, gravity sanitary sewers, and storm sewers.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for ductile iron pipe and fittings under this Section, with the exception of extra fittings in place. Include cost in unit prices for work as specified in the following Sections, as applicable:

a. 33 11 00 - Water Utility Distribution Piping.
b. 33 31 00 – Sanitary Utility Sewerage Piping.
c. 33 41 00 - Storm Utility Drainage Piping.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

A. ANSI A 21.4 (AWWA C 104) - Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings, for Water and Other Liquids.

B. ANSI A 21.10 (AWWA C 110) - Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in., for Water and Other Liquids.

C. ANSI A 21.11 (AWWA C 111) - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

D. ANSI A 21.15 (AWWA C 115) - Flanged Ductile-Iron Pipe with Threaded Flanges.

E. ANSI A 21.50 (AWWA C 150) - Thickness Design of Ductile-Iron Pipe.

F. ANSI A 21.51 (AWWA C 151) - Ductile-Iron Pipe, Centrifugally Cast for Water and Other Liquids.

G. ANSI A 21.53 (AWWA C 153) - Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for water service.

H. ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

I. ASTM D 1248 - Polyethylene Plastics Molding and Extrusion Materials.

J. ASTM G 62 - Test Methods for Holiday Detection in Pipeline Coatings.

K. AWWA C 600 - Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.

L. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.

1.04 SUBMITTALS

A. Conform to requirements of Section - Submittal Procedures.

B. Submit shop drawings showing design of pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings. Production of pipe and fittings prior to review by Engineer is at Contractor's risk.

1.05 QUALITY CONTROL

A. Provide manufacturer's certifications that all ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.

B. Provide certifications that all pipe joints have been tested and meet requirements of ANSI A 21.11.

PART 2 P R O D U C T S

2.01 DUCTILE IRON PIPE

A. Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water mains and Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

2.02 JOINTS

A. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.15 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, bolts shall conform to requirements of AWWA C 111.

B. Where restrained joints for buried service are required by Drawings, provide one of the following, or equal:

1. Super-Lock Joint by Clow Corporation.
2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
3. TR-Flex Joint by U.S. Pipe and Foundry Company.

C. Threaded- or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.

D. Provide for restrained joints designed to meet test pressures required under Section 33 13 00.10 - Hydrostatic Testing of Pipelines as applicable.

E. Where ductile iron water main is cathodically protected from corrosion, bond rubber gasketed joints as shown on Drawings to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

2.03 GASKETS

A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material; for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed pipeline, shall have the following gasket materials for the noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by the pipe manufacture

2.04 FITTINGS

A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they serve.

B. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

C. Flanged Fittings: ANSI A 21.10; ANSI B 16.1 cast or ductile iron. Flanges: ANSI B 16.1, Class 125; pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A 21.11 (AWWA C 110); pressure rated at 250 psi.

E. Ductile Iron Compact Fittings for Water Mains: ANSI A 21.53; 4-inch through 12-inch diameter; cement-mortar lining; conform to requirements Division 33 - Polyethylene Wrap.

2.05 COATINGS AND LININGS

A. Water Main Interiors: ANSI A21.4, cement lined with seal coat.

B. Sanitary Sewer and Force Main Interiors:

1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
2. Liner thickness: Nominal 40 mils, minimum 35 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.
3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.
4. Acceptable Lining Materials:

    a. Virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage heat bonded to interior surface of pipe and fittings; APolyline@ by American Cast Iron Pipe Company; or equal.
    b. Polyurethane: Corro-pipe II by Madison Chemicals.
    c. Ceramic Epoxy: Protecto-401 by Enduron Protective Coatings.

C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.

D. Exterior: Prime coat and outside asphaltic coating conforming to ANSI A 21.10, ANSI A 21.15, or ANSI A 21.51 for pipe and fittings in open cut excavation and in casings.

E. Polyethylene Wrap: For buried water lines and sanitary sewers, including point repairs, provide polyethylene wrap unless otherwise specified or shown. Provide polyethylene wrap for buried ductile iron pipe, including polyurethane coated pipe. Conform to requirements of Division 33 - Polyethylene Wrap.

F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer as resistant to the contaminants identified in the Phase II Environmental Site Assessment Report.

2.06 MANUFACTURERS

A. Pre-approved manufacturers of ductile iron pipe are American Cast Iron Pipe Co., McWayne Cast Iron Pipe Co., and U. S. Pipe and Foundry Co.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to installation requirements of Sections 33 11 00 - Water Utility Distribution Piping, and 33 31 00 – Sanitary Utility Sewerage Piping, except as modified in this Section.

B. Install in accordance with AWWA C 600 and manufacturer's recommendations.

C. Install all ductile iron pipe in polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.

3.02 GRADE

A. Unless otherwise specified on Drawings, install ductile iron pipe for water service to clear utility lines with following minimum cover:

Diameter (Inches)	Depth of Cover (Feet)
16 and 24	5
12 and smaller	4

END OF SECTION 33 06 10.15

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SECTION 33 06 40.10

HDPE SOLID AND PROFILE WALL PIPE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.

B. High density polyethylene (HDPE) pipe for sanitary sewer force mains, including fittings.

C. High density polyethylene (HDPE) pipe for storm sewers culverts.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for work, as specified in Division 31.
2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Drainage Pipe, 18"-48" diameter.

B. AASHTO Section 18 - Soil Thermoplastic Pipe Interaction Systems.

C. AASHTO Section 30 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.

D. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.

E. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

F. ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.

G. ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.

H. ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

I. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

K. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

L. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

M. ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.

N. ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

A. Provide manufacturer's certificate of conformance to Specifications.

B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

C. Owner’s Representative reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.

1. Manufacturer's Notification: Should Owner’s Representative wish to witness manufacture of specific pipes, manufacturer shall provide Owner’s Representative with minimum three weeks notice of when and where production of those specific pipes will take place.
2. Failure to Inspect. Approval of products or tests is not implied by Owner’s Representative's decision not to inspect manufacturing, testing, or finished pipes.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

PART 2 P R O D U C T S

2.1 GENERAL

A. For sanitary sewer pipe provide HDPE pipe as follows:

1. NEW CONSTRUCTION PIPE PRODUCTS GRAVITY SANITARY SEWER DIRECT BURY

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM or AASHTO	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02505	Solid Wall Polyethylene (HDPE)	Chevron Plexco Phillip 66 Quail Poly Pipe	ASTM F-714	DR 17 DR 21	115 46	8” – 10” 12” – 48”
02531	Polyethylene Profile Wall	Spirolite	ASTM F-894	n/a	46	18”–120”

2. REHABILITATION CONSTRUCTION PIPE PRODUCTS SLIPLINING OF SANITARY SEWER

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02550	Solid Wall Poly	Chevron Plexco Quail Poly Pipe AmeriFlow by NAPCO Ameriflow by KWH	F-714	DR 21	46	8” – 48” 3” – 12” 14” – 63”
02550	Polyethylene Profile Wall	Spirolite	F-894	n/a	46	18”–120”

B. For Storm Sewer and Residential Driveway Culverts provide HDPE as follows:

1. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
2. Sure-Lok F477 by Hancor, Inc.

C. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.

D. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.

E. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.

F. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:

1. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged conforming to the requirements of ASTM F-477.

G. Jointing:

1. Gaskets:
   a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.
   b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by pipe manufacturer

2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.2 MATERIALS FOR SANITARY SEWER

A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.

B. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

2.3 MATERIALS FOR STORM SEWERS AND RESIDENTIAL DRIVEWAY CULVERTS

A. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M 294, AASHTO MP7 and ASTM D 3350.

B. Types: CPP shall meet one or both of following:

1. Type S: Outer corrugated wall with smooth inner liner.
2. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.

C. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.4 TEST METHODS FOR SANITARY SEWER

A. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner’s Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F

and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.

C. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.

D. Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.5 TEST METHODS FOR STOMR SEWERS AND RESDENTIAL DRIVEWAY CULVERTS

A. Pipe stiffness at 5 percent deflection, when determined in accordance with ASTM D 2412, shall be as specified in Section 7.4 of AASHTO M 294.

B. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M 294.

2.6 MARKING

A. Mark each standard and random length of pipe in compliance with these Specifications with following information:

1. Pipe size.
2. Pipe class.
3. Production code.
4. Material designation.

PART 3 E X E C U T I O N

3.1 INSTALLATION

A. Conform to requirements of Division 33.

B. Install pipe in accordance with the manufacturers recommended installation procedures.

C. HDPE pipe is not approved in applications requiring augering of pipe.

D. Bedding and backfill: Conform to requirements of Division 31.

END OF SECTION 33 06 40.10

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SECTION 33 06 40.11

REINFORCED CONCRETE PIPE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Reinforced concrete pipe for storm sewers.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for reinforced concrete pipe under this Section. Include cost in unit price work as specified in the following Sections:

a. 33 41 00 – Storm Utility Drainage Piping

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this section is included in the total Stipulated Price.

1.03 REFERENCES

A. ASTM C 76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe.

C. ASTM C 497 - Method of Testing Concrete Pipe, Sections, or Tile.

D. ASTM C 506 - Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.

E. ASTM C 507 - Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.

F. ASTM C 655 - Reinforced Concrete D-load Culvert, Storm Drain and Sewer Pipe.

G. ASTM C 822 - Standard Definitions and Terms Relating to Concrete Pipe and Related Products.

H. ASTM C 877 - Standard Specification for External Sealing Bands for Non circular Concrete Sewer, Storm Drain, and Culvert Pipe.

1.04 SUBMITTALS

A. Submittals shall conform to requirements in Division 1.

B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.

C. Submit certificates by a testing laboratory, hired and paid by the manufacturer, that concrete pipes meet applicable standards when tested in accordance with ASTM C 497.

PART 2 P R O D U C T S

2.01 REINFORCED CONCRETE PIPE

A. Circular reinforced concrete pipe shall conform to requirements of ASTM C 76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C 443.

B. Reinforced concrete arch pipe shall conform to the requirements of ASTM C 506 for Class A-III. Joints shall conform to ASTM C 877.

C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C 877.

D. Reinforced concrete D-load pipe shall conform to the requirements of ASTM C 655.

2.02 GASKETS

A. When no contaminant is identified, furnish rubber gasket conforming to ASTM C 443 for circular reinforced concrete pipe and rubber gasket conforming to ASTM C 877 for reinforced concrete elliptical pipe.

B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants:

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by the pipe manufacturer

2.03 SOURCE QUALITY CONTROL

A. Representatives of Engineer will inspect manufacturer's plant and casting operations as deemed necessary.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to requirements of the following Sections, as applicable:

1. 33 41 00 - Storm Utility Drainage Piping

B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

END OF SECTION 33 06 40.11

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Installation of water lines.

B. Specifications identify requirements for both small diameter water lines and large diameter water lines. When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for water lines installed by open-cut, augered with or without casing, aerial crossing, and pipe offset section or within limits of Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis for each size of pipe installed. Separate pay items are used for each type of installation.
   a. Mains: Measure along axis of pipe and include fittings and valves.
   b. Branch Pipe: Measure from axis of water line to end of branch.
2. Payment for interconnection is on lump sum basis for each interconnection identified on Drawings. Payment will include tapping sleeve and valves piping, connections and other related work necessary for construction as shown on Drawings or specified herein.
3. Payment for removal of existing internal elliptical or dished head plug is on unit price basis for each internal elliptical or dished head plug removed. Payment will include deletion of plug, drainage or dewatering of water lines, repair of damaged linings, rechlorination and items incidental to operation.
4. Payment for plug and clamp is on a unit price basis for each size of pipe.
5. Payment for drainline connection with service manhole is on unit price basis for each drainline shown on drawings. Payment includes valve, access manhole and connection.
6. Payment for cylindrical corrosion barriers is on a unit price basis for each pipe fitting installed with one or more barriers.
7. When directed by Owner’s Representative to install extra fittings as required to avoid unforeseen obstacles, payment will be based on the following:
   a. Each extra fitting requested by Owner’s Representative and delivered to jobsite will be paid according to unit price for "Extra Fittings in Place."
   b. Payment will include and be full compensation for items necessary for installation and operation of water line.
8. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings

B. ANSI/NSF Standard 61 - Drinking Water System -Health Components

C. ASTM A 36 - Standard Specification for Carbon Structural Steel

D. ASTM A 536 - Standard Specification for Ductile Iron Castings

E. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

F. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes

G. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes

H. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar

I. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.

J. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination

K. ASTM E 709 - Standard Guide for Magnetic Particle Examination

L. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe

M. AWWA C 206 - Standard for Field Welding of Steel Water Pipe

N. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Conform to submittal requirements of applicable Section for type of pipe used.

C. Photographs: Submit photographs conforming to requirements of Division 1 prior to commencement of construction.

D. Submit videotapes conforming to requirements of Division 1, if applicable.

E. Submit Lone Star notification transmittal number prior to beginning excavation.

F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:

1. Disinfection; not to exceed 4,000 linear feet per section.
2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
3. Site restoration; not to exceed limits specified; Sequence in order of disturbance.

PART 2 P R O D U C T S

2.1 PIPE MATERIALS

A. Install pipe materials which conform to Division 33.

B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.

C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.

D. Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

2.2 WELDED JOINT PROTECTION FITTING FOR SMALL DIAMETER STEEL PIPE

A. Cylindrical Corrosion Barrier: Provide approved cylindrical corrosion barrier.

B. O-rings: Conform to National Sanitary Foundation requirements.

2.3 RESTRAINED JOINTS

A. Ductile-Iron Pipe: See Division 33.

B. PVC Pipe: See Division 33. Perform hydrostatic testing in accordance with ASTM F 1674.

C. Prestressed Concrete Cylinder Pipe, Bar-Wrapped Pipe and Steel Pipe: Welded joints (see Paragraph 3.06 D).

D. Restrained Joints where required on DIP and PVC pipe:

1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.
2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

2.4 COUPLINGS AND APPURTENANCES FOR LARGE DIAMETER WATERLINE

A. Flexible (Dresser-type) Couplings.

1. Install where shown on Drawings or where allowed by Owner’s Representative for Contractor's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene or Buna-N.
2. For steel pipe; provide approved sleeve-type flexible couplings. Thickness of middle ring equal to or greater than thickness of pipe wall.
3. Provide approved flanged adapter couplings for steel pipe.
4. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of approved coal tar coating.

B. Flap Valves: Provide approved flap valves on discharge of manhole drainline as shown on Drawings.

1. Body and Flap: ASTM A 126-B cast iron.
2. Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.
3. Resilient Seat
4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.
5. Hinge pins: ASTM B 98-CA655 silicon bronze.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Conform to applicable installation specifications for types of pipe used.

B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.

C. Lay pipe to lines and grades shown on Drawings.

D. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes or separation of four feet minimum from force mains as specified in this Section in all directions unless special design is provided on Drawings.

E. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Owner's Representative before proceeding with construction.

F. Inform Owner's Representative if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Owner's Representative.

G. For projects involving multiple subdivisions or locations, limit water line installation to maximum of two project site locations. Maximizing 2 pipe installation crews shall be permitted, unless otherwise approved by Owner's Representative.

H. Only the appropriate governing agency will handle operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.

I. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.

J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.

K. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.

L. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Owner's Representative.

3.2 HANDLING, CLEANING AND INSPECTION

A. Handling:

1. Place pipe along project site where storm water or other water will not enter or pass through pipe.

2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
5. Use precautions to prevent injury to pipe, protective linings and coatings.
    a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
    b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
    c. Do not lift pipe using hooks at each end of pipe.
    d. Do not place debris, tools, clothing, or other materials on pipe.
6. Repair damage to pipe or protective lining and coating before final acceptance.
7. For cement mortar line and coated steel pipe and PCCP, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:
    a. In surface laitance of centrifugally cast concrete.
    b. In sections of pipe with steel reinforcing collars or wrappers.
    c. Within 12 inches of pipe ends.
8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.

B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.

C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.3 EARTHWORK

A. Conform to applicable provisions of Division 31.

B. Bedding: Use bedding materials in conformance with Division 31.

C. Backfill: Use bank run sand or earth or native soil as specified in Division 31. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.

D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density Water tamping is not allowed.

E. Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

3.4 PIPE CUTTING

A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Owner's Representative. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.5 PIPING INSTALLATION

A. General Requirements:

1. Lay pipe in subgrade free of water.
2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
3. Properly form bedding to fully support bell without wedging or blocking up bell.
4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.

B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Owner's Representative prior to skipping any portion of Work.

C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

D. Perform Critical Location as shown on Drawings. Refer to Division 33 for additional requirements at critical locations.

E. Laying Large Diameter Water Line

1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
2. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Owner's Representative. No additional payment will be made for higher class of pipe or improved bedding.
3. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
4. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
5. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.
6. Prior to proceeding with critical tie-ins submit sequence of work based on findings from "critical location" effort.

F. Perform following additional procedures when working on plant sites.

1. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with Owner's Representative and Water Production personnel. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until Owner's Representative agrees key personnel, equipment and materials are on hand to complete Work.
2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by Owner's Representative and the governing agency is present to observe.
4. Coordinate with the governing agency to obtain reduction in operating pressures prior to performing connections to existing piping.
5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Owner's Representative.
6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Division 1.
7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.
8. Submit to Owner's Representative Lone Star Notification transmittal number prior to beginning excavation.
9. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.
10. Provide adequate notice to pipe manufacture's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
11. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Division 1.
12. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to Owner's Representative by noon on Thursday of week. Contact person must be accessible during weekend, have Houston Metro Area phone number, and be authorized to make emergency decisions.
13. No night work or plant shut down will be scheduled to begin two working days before or after designated Holidays.

G. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide governing agency a minimum of two weeks notice prior to shutting down existing water line.

3.6 JOINTS AND JOINTING

A. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped Pipe PVC, Steel, and DIP:

1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.

4. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.
5. Where preventing movement of 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
    a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.
    b. Do not include passive resistance of soil in thrust restraint calculations.
6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Owner's Representative.

B. Flanged Joints where required on Concrete Cylinder Pipe, Bar Wrapped Pipe, Ductile Iron Pipe, or Steel Pipe:

1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south center line. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Densco petroleum based tape or approved equal for all exposed portions of nuts, bolts and pipe.
4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with City of Houston's "Approved Products List."
5. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrite seal, conforming to ANSI A 21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.

C. Welded Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):

1. Prior to starting work, provide certification of qualification for welders employed on project for type of work procedures and positions involved.
2. Joints: AWWA C 206. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
3. Furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
4. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1 ½ inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true, and preserve alignment during welding operation. For butt welded joints, align abutting ends to minimize offset

between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, take care to avoid damage to linings and coatings.

5. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
6. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
7. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
8. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.
9. Do not weld under weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
10. Make tack weld of same material and by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
11. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
12. Welded Joints for Large Diameter Water Lines:
    a. Furnish pipe with trimmed spigots and interior welds for 36-inch and larger pipe.
    b. Use exterior welds for 30 inch and smaller.
    c. Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2 ½ degrees.
    d. For large diameter water lines, employ an independent certified testing laboratory, approved by Owner's Representative, to perform weld acceptance tests on welded joints. Include cost of such testing and associated work to accommodate testing in contract unit price bid for water line. Furnish copies of test reports to Owner's Representative for review. Owner's Representative has final decision as to suitability of welds tested.
        1) Weld acceptance criteria:
            a) Conduct in accordance with ASTM E165- Standard Test Method for Liquid Penetrant Examination and ASTM E709 Standard Guide for Magnetic Particle Examination. Use X-ray methods for butt welds, for 100 percent of joint welds.
            b) Examine welded surfaces for the following defects:
                (1) Cracking
                (2) Lack of fusion/penetration
                (3) Slag which exceeds one-third (t) where (t) equals material thickness
                (4) Porosity/Relevant rounded indications greater than 3/16 inch; rounded indication is one of circular or elliptical shape with length equal to or less than three times its width
                (5) Relevant linear indications in which length of linear indication exceeds three times its width
                (6) Four or more relevant 1/16-inch rounded indications in line separated by 1/16 inch or less edge to edge
13. After pipe is joined and prior to start of welding procedure, make spigot and bell essentially concentric by jacking, shimming or tacking to obtain clearance tolerance around periphery of joint except for deflected joints.
14. Furnish each welder employed steel stencil for marking welds, so work of each welder can be identified. Mark pipe with assigned stencil adjacent to weld. When welder leaves job, stencil must be voided and not duplicated. Welder making defective welds must discontinue work and leave project site. Welder may return to project site only after recertification.
15. Provide cylindrical corrosion barriers for epoxy lined steel pipe 24-inch diameter and smaller, unless minimum wall thickness is 0.5 inches or greater.

a. In addition to welding requirements contained here in Paragraph 3.06, conform to protection fitting manufacturer's installation recommendations.
b. Provide services of technical representative of manufacturer available on site at beginning of pipe laying operations. Representative to train welders and advise regarding installation and general construction methods. Welders must have 12 months prior experience installing protection fittings.
c. All steel pipe is to have cutback 3/4 inch to no greater than 1 inch of internal diameter coating from weld bevel.
d. Furnish steel fittings with cylindrical corrosion barriers with shop welded extensions to end of fittings. Extension length to measure no less than diameter of pipe. Shop apply lining in accordance with AWWA C 210 or AWWA C 213.
e. All steel pipe receiving field adjustments are to be cold cut using standard practices and equipment. No cutting using torch is to be allowed.

D. Harnessed Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe):

1. Use of snap-ring type restrained joints on pipe is limited to 20-inch through 48-inch diameters.
2. Position snap-ring joint bolt on top (12 o'clock portion). Provide minimum 1/2-inch joint recess. Use joint "diapers" minimum of 12 inches wide.
3. For field adjustments with deflections beyond manufacturer's recommendations:
   a. Field trim spigot.
   b. Do not engage ring.
4. Harnessed joints are not permitted in areas defined on Drawings as potentially petroleum contaminated material, in tunnels, or at bend greater than 5 degrees.
5. Install harness type joints including snap rings at straight sections of pipe.

E. Restrained Joints

1. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks.
2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of prestressed concrete cylinder pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer in State of Texas for review by Owner’s Representative. Make adjustments in thrust restraint lengths at no additional cost to Owner.
3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
4. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
5. Installation.
   a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
   b. Examine and clean mechanism; remove dirt, debris and other foreign material.
   c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
   d. Verify gasket is evenly seated.
   e. Do not over stab pipe into mechanism.
6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.

7. Place 2500 psi concrete conforming to Division 32, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.

F. Joint Grout (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):

1. Mix cement grout mixture by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Place grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
2. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without retempering. Use grout for filling grooves of such consistency that it will adhere to ends of pipe.
3. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
4. Follow established procedures for hot and cold weather concrete placement.
5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.
6. Grouting exterior joint space: Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
7. Interior Joints for Pipe 24 inches and Smaller: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use swab approved by Owner’s Representative for 20-inch pipe and smaller.
8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if joint bands are protected by zinc metallizing or other approved protective coatings.
9. Remove and replace improperly cured or otherwise defective grout.
10. Strike off grout on interior joints and make smooth with inside diameter of pipe.
11. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply approved flexible sealer, such as Flex Protex or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.

12. Interior Joints for Water Lines 30 inches and Larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe using steel trowel so that surface is smooth. Accomplish grouting at end of each work day. Obtain written acceptance from Owner's Representative of inside joints before proceeding with next day's pipe laying operation. During inspection, insure no delamination of joint mortar has occurred by striking joint mortar lining with rubber mallet. Remove and replace delaminated mortar lining.
13. Work which requires heavy equipment to be over water line must be completed before mortar is applied to interior joints.

G. Large Diameter Water Main Joint Testing: In addition to testing individual joints with feeler gauge approximately 1/2 inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. Perform tests at no additional cost to Owner.

H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Owner's Representative. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.

1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
4. Replace, repair, or reapply coatings and linings as required.
5. Assessment of deflection may be measured by Owner's Representative at location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
6. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.

I. Closures Sections and Approved Field Modifications to Steel, Concrete Cylinder Pipe, Bar Wrapped Pipe and Fittings:

1. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.
2. Fill exposed interior and exterior surfaces with nonshrink grout.
3. For pipe diameters 36 inches and greater, perform field welds on interior and exterior of pipe.
4. For large diameter water lines, provide minimum overlap of 4 inches of butt strap over adjacent piece on butt-strap closures.

3.7 CATHODIC PROTECTION APPURTENANCES

A. Where identified on Drawings, modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits including test stations at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water line, access manhole piping and other major openings in water line, or as shown on Drawings.

B. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint or as shown on Drawings. No additional bonding required where joints are welded for thrust restraint. Repair coatings as specified by appropriate AWWA standard, as recommended by manufacturer, and as approved by Owner's Representative.

C. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

3.8 SECURING, SUPPORTING AND ANCHORING

A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.

B. Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.9 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE

A. Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.

B. Do not use polyethylene wrap if pipe is cathodically protected.

C. Conform to requirements of Division 33.

3.10 CLEANUP AND RESTORATION

A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old water lines, backfill and surface restoration.

B. Unless otherwise approved by Owner's Representative, comply with the following:

1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.
2. No later than three days after completing disinfection preparatory work, execute disinfection work.
3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
4. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Division 1.
5. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

C. For large diameter water lines, do not install more than 2,000 linear feet of water line, without previous 2,000 linear feet being restored in accordance with Division 1. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet. Failure to comply with this requirement shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

3.11 CLEANING PIPING SYSTEMS

A. Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning. Owner's Representative must inspect water line for cleanliness prior to filling.

3.12 DISINFECTION OF WATER LINES

A. Conform to requirements of Division 33.

3.13 FIELD HYDROSTATIC TESTS

A. Conform to requirements of Division 33.

END OF SECTION 33 11 00

SECTION 33 12 13.10

TAPPING SLEEVES AND VALVES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Tapping sleeves and valves for connections to existing water system.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment is on unit price basis for each tap installed.
2. Refer to Division 1 for unit price procedures.
3. For water lines 4-inches and greater, no payment will be made until coupon (cut out portion of pipe tapped) is delivered to the Owner.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

B. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

C. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service.

D. AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.

E. AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.

F. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.

G. AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit results of tapping sleeves NPT test opening.

C. Submit manufacturer's affidavit as required in Division1.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Tapping Sleeves:

1. Tapping Sleeve Bodies: AWWA C 110 cast or ductile iron or AWWA C 200 carbon steel in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts with mechanical joint ends.
2. Branch Outlet of Tapping Sleeve:
   a. Flanged, machined recess, AWWA C 207, Class D, ANSI 150 pound drilling.
   b. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
3. Use cast iron split sleeve where fire service from 6-inch water line is approved.

B. Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:

1. Flange: AWWA C 207, Class D, ANSI 150 pound drilling.
2. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
3. Steel sleeves are restricted to use on pipe sizes 6 inches and larger.
4. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against outside diameter of pipe.
5. Bolts: AWWA C 500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.
6. Steel Sleeves Finish: Fusion-bonded epoxy coated to minimum 12 mil thickness.
7. Finished Epoxy Coat: Free of laminations and blisters; and remain pliant and resistant to impact with non-peel finish.
8. Provide approved steel tapping sleeves.
9. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.
10. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.

C. Stainless Steel tapping-sleeve bodies and flange may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:

1. Flange: ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling.
2. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
3. Stainless Steel sleeves are restricted to use on pipe sizes 4 inches and larger.
4. Body: ASTM A240 Stainless Steel, Type 304.
5. Bolts: ASTM A193 Stainless Steel, Type 304.
6. Nuts: ASTM A194 Stainless Steel, Type 304.
7. Branch Outlet: Heavy Stainless Steel Pipe.
8. Provide approved stainless steel tapping sleeves.
9. Do not use stainless steel sleeves for taps greater than 75 percent of pipe diameter.

D. Tapping Valves: Meet requirements of Division 33 with following exceptions:

1. Inlet Flanges:
   a. AWWA C 110; Class 125.
   b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.
2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; double disc.

E. Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Division 33.

PART 3 E X E C U T I O N

3.1 APPLICATION

A. Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.

B. Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.

C. Hydrostatically test installed tapping sleeve to 150 psig for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.

D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.

E. Do not use Large End Bell (LEB) increasers with next size tap unless existing pipe is asbestos-cement.

3.2 INSTALLATION

A. Verify outside diameter of pipe to be tapped prior to ordering sleeve.

B. Tighten bolts in proper sequence so that undue stress is not placed on pipe.

C. Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.

D. Make tap with sharp, shell cutter:
1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.

E. Withdraw coupon and flush cuttings from newly-made tap.

F. Wrap:
1. For 12-inch and smaller tap, wrap completed tapping sleeve and valve in accordance with Division 2.
2. For 16-inch and larger tap, apply coal tar epoxy around completed tapping sleeve and valve. The coal tar epoxy shall be applied with minimum of two (2) coats. Each coat of coal tar epoxy shall have minimum dry film thickness of 16 mils.

G. Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).

H. Request inspection of installation prior to backfilling.

I. Backfill in accordance with Division 31.

END OF SECTION 33 12 13.10

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SECTION 33 12 13.12

WET CONNECTIONS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Wet connections for new water mains and service lines to existing water mains.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for wet connections shown on Drawings is based on each wet connection. Separate payment will be made for each size of water main.
2. No compensation will be given for extra work or for damage occurring as a result of an incomplete shutoff.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

A. AWWA C 800 - Underground Service Line Valves and Fittings.

1.04 DEFINITIONS

A. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining the isolated sections, and completing the connections.

B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of a 2-inch service line.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Pipe shall conform to requirements of applicable portions of Division 33 related to piping materials and to water distribution.

B. Corporation cocks and saddles shall conform to requirements in Division 33.

C. Valves shall conform to requirements of Section 33 12 16 – Water Utility Distribution Valves.

D. Brass fittings shall conform to requirements of AWWA C 800.

PART 3 E X E C U T I O N

3.01 CONNECTION OPERATIONS

A. Plan wet connections in such manner and at such hours as to least inconvenience public. Notify Engineer at least 48 hours in advance of making connections.

B. Do not operate valves on mains in use by Owner. Owner Representative will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections.

C. Conduct connection operations when Owner Representative is at job site. Connection work shall progress without interruption until complete once existing mains have been cut or plugs has been removed for making connections.

3.02 2-INCH WET CONNECTIONS

A. Tap water main. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing main. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION 33 12 13.12

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Gate valves.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for gate valves 20 inches in diameter and smaller under this Section. Include payment in unit price for water lines.
2. Payment for gate valves 24 inches to 36 inches in diameter is on a unit price basis. Unit price includes cost of required box for gate valves.
3. Payment for 2-inch blow-off valve with box is on a unit price basis for each installation.
4. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.

C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.

D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.

E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.

F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.

G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.

H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturer's product data for proposed valves for approval.

C. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

1.5 QUALITY CONTROL

A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. Direct bury valves and those in subsurface vaults open clockwise; aboveground and plant valves open counterclockwise.

B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 20-inches and smaller. When type of valve is indicated, no substitute is allowed.

C. Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends.

D. Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.

E. Gate Valves 2 inches in diameter: Iron body, double disc or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating clockwise to open.

F. Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:

1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.

G. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.

H. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.

I. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

J. Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved

double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:

1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
7. Discs: Cast iron with bronze disc rings securely penned into machined dovetailed grooves.
8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.
9. Provide bypass for valves 24 inches and larger.
10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
12. Stuffing Boxes: Located on top of bonnet and outside gear case.

K. Gate valves 14 inches to 24 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.

1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
3. Ensure wedge is symmetrical and seals equally well with flow in either direction.
4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.
6. Provide high strength bronze stem and nut.
7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.
9. Provide thrust washers to the thrust collar for easy valve operation.

L. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.

M. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.

N. Gate Valves for Tapping Steel Pipe: Provide double disc gate valve. Resilient wedge gate valve shall only be installed in a vertical position.

O. Provide flanged joints when valve is connected to steel or PCCP.

PART 3 E X E C U T I O N

3.1 INSTALLATION

A. Earthwork. Conform to applicable provisions of Division 31.

B. Operation. Do not use valves for throttling without prior approval of manufacturer.

3.2 SETTING VALVES AND VALVE BOXES

A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.

B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.

C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve.

D. Assemble and brace box in vertical position as indicated on Drawings.

3.3 DISINFECTION AND TESTING

A. Assist Owner's Representative with disinfection of valves and appurtenances as required by Division 33 and test as required by Division 33.

B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

D. Repair or replace valves which exceed leakage rate.

END OF SECTION 33 12 16

SECTION 33 12 19

WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Fire hydrants.

B. Adjustment of fire hydrants and gate valves.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment is on a unit price basis for each fire hydrant assembly, including 6-inch gate valve and box, installed regardless of barrel depth.
2. Payment for fire hydrant branches (leads) is on linear foot basis for each branch installed. Separate pay items are used for open-cut and augered branches.
3. Payment for salvaged fire hydrants is on unit price basis for each fire hydrant removed and returned to Owner's Maintenance Quadrant Stock yard.
4. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants

B. SSPC SP2 - Hand Tool Cleaning

C. SSPC SP3 - Power Tool Cleaning

D. SSPC SP10 - Near-White Blast Cleaning

E. SSPC SP11 - Power Tool Cleaning to Bare Metal

F. SSPC Paint Spec No.21

G. SSPC-Paint 21 - White or Colored Silicone Alkyd Paint

H. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

I. SSPC-Paint 104 - White or Tinted Alkyd Paint

J. Federal Standard A-A-2962A - Enamel, Alkyd, Solvent Based Low VOC

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit name of hydrant manufacturer, type of bonnet paint, and engineering control drawing number for hydrant proposed for use.

PART 2 P R O D U C T S

2.1 HYDRANTS

A. Provide approved fire hydrants.

B. The Owner's Representative may, at any time prior to or during installation of hydrants, randomly select furnished hydrant for disassembly and laboratory inspection, at Owner's expense, to verify compliance with Specifications. When hydrant is found to be non-compliant, replace, at Contractor's expense, hydrants, with hydrants that comply with Specifications.

C. Provide lower hydrant barrel fabricated from Ductile Iron Pipe as single piece, connected to upper hydrant barrel by means of joint coupling that will provide three hundred sixty degree (360) rotation of upper barrel.

2.2 LEADS

A. Branches (Leads): Conform to requirements of Division 33.

2.3 HYDRANT PAINTING

A. New hydrants and refurbished hydrants shall be shop coated as specified herein.

B. Exterior Above Traffic Flange (Including Bolts & Nuts).

1. Surface preparation to be in accordance with SSPC-SP 10 (MACE 2) near white blast cleaned surface.
2. Coat with three coat alkyd/silicone alkyd system with total dry film thickness (DFT) of 6 - 9 mils as follows:
   a. Prime Coat - Oil modified alkyd primer, to be in general conformance with SSPC Paint Specification No. 25. Total dry film thickness (DFT) 2 - 3 mils.
   b. Intermediate Coat - Heavy Duty Industrial Alkyd Enamel to be in general conformance with SSPC Paint Specification No. 104, and Federal Standard A-A-2962A. Total dry film thickness (DFT) of 2 -3 mils.
   c. Finish Coat - Silicone Alkyd Resin Enamelto be in general conformance with SSPC Paint Specification No. 21. Total dry film thickness (DFT) to be 2 - 3 mils. Exception – hydrant bonnet shall not be finished shop coated, only intermediate coated. Install color coded finish coating of bonnet in field.
   d. Bonnet Paint - Field apply finish coat of Silicone Alkyd Resin Enamel to be in general conformance with SSPC Paint Specification No. 21. Dry film thickness of 2 - 3 mils. Bonnet colors are to be as specified in Paragraph 3.01 to designate the appropriate size of water supply line.
3. Colors - Primer: Manufacturers standard color. Finish coat of hydrant body : As specified by Owner . Connection caps: Finished coated white. Paint white band of finish coat two (2) inches in width on hydrant body approximately six inches (6") above and parallel to traffic flange. Intermediate coat: Contrasting color to blue finish, such as white.

C. Field Maintenance Painting (Exterior Above Traffic Flange)

1. Surface Preparation to be in accordance with SSPC - SP2, Hand Tool Cleaning, or SSPC -SP3, Power Tool Cleaning, depending on condition of existing paint and extent of corrosion. It is not necessary to remove tightly adhered mill scale, rust, and paint. Mill scale, rust and paint are considered tightly adherent when they cannot be

removed with dull putty knife. In some severe cases where it is necessary to remove majority of existing paint, surface should be cleaned in accordance with SSPC -SP11, Power Tool Cleaning to Bare Metal.

2. When surface is cleaned to bare metal (SSPC - SP11), coat hydrant with three coat Alkyd/Silicone Alkyd system in accordance with Paragraph 2.03.B.2 as for new hydrants. When surface is cleaned to SSPC - SP2 or SSPC - SP3, coat hydrant with Silicone Alkyd Resin Enamelin general conformance with SSPC Paint Specification No. 21. Total dry film thickness of 3 - 6 mils.

D. Exterior Below Traffic Flange

1. Surface preparation in accordance with SSPC- SP10 (MACE 2) Near White Blast Cleaned Surface.
2. Primer and intermediate coat: coal tar epoxy in general conformance with SSPC Paint Specification No. 16. Apply two (2) coats with dry film thickness (DFT) of 8 - 10 mils each for total DFT of 16 -20 mils.
3. Finish coat: Water based vinyl acrylic mastic Apply one coat with dry film thickness of 6 - 8 mils. Color of finish coat to be same as finish coat for exterior above traffic flange, i.e., blue. (Acro 555 Crystal Blue, or equivalent.)

E. Interior Surfaces Above and Below Water Line Valve

1. Material used for internal coating of hydrant interior ferrous surfaces below water line valve must be NSF certified as suitable for contact with potable water as required by Chapter 290, Rules and Regulations for Public Water Systems, Texas Natural Resources Conservation Commission.
2. Coating shall be liquid or powder epoxy system in accordance with AWWA Standard C - 550 (latest revision). Coating may be applied in two or three coats, according to manufacturer's recommendations, for total dry film thickness of 12 -18 mils.

PART 3 E X E C U T I O N

3.1 INSTALLATION

A. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete.

B. Locate nozzle center line minimum 18 inches above finish grade.

C. Place 12-inch by 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by Owner’s Representative) on pumper nozzles of new or relocated fire hydrants installed on new water lines not in service. Remove indicators after new water line is tested and approved by Owner’s Representative.

D. Do not cover drain ports when placing concrete thrust block.

E. Obtain Owner’s Representative’s approval in writing prior to installation of hydrants which require changes in bury depth due to obstructions not shown on Drawings. Unit price adjustments will not be allowed for changes in water line flow line or fire hydrant barrel length caused by obstructions.

F. Plug branch lines to valves and fire hydrants shown on Drawings to be removed. Deliver fire hydrants designated for salvage to nearest Utility Maintenance Quadrant Facility.

G. Install branches (leads) in accordance with Division 33.

H. Coating Requirements:

1. Apply coatings in strict accordance with manufacturer's recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.
2. Furnish affidavit of compliance that coatings furnished complies with requirements of this specification and referenced standards, as applicable.

I. Field coat hydrant bonnet to indicate size of water line supplying hydrant or tested flow at the fire hydrant as directed by the Fire Marshall or Owner.

J. Remove and dispose of unsuitable materials and debris in accordance with requirements of Division 1.

END OF SECTION 33 12 19

SECTION 33 12 40

VALVE BOXES, METER BOXES, AND METER VAULTS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Valve boxes for water service.

B. Meter boxes for water service.

C. Meter vaults for water service.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for valve boxes under this Section. Include payment in unit price for Division 1.
2. No separate payment will be made for meter boxes under this Section. Include payment in unit price for Division 1.
3. Payment for each size of meter vaults is on unit price basis per vault. Payment will be made for each vault installed, regardless of depth.
4. Refer to Division 1.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM A 48 - Standard Specification for Gray Iron Castings.

B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.

D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

F. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturers' product data for following items for approval:

1. Each type of valve box and lid.
2. Each type of meter box and cover.
3. Each type of meter vault frame and cover.

C. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in State of Texas.

D. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.

E. Submit manufacturer's certification that plastic meter boxes meet requirements of Paragraph 2.05, Plastic Meter Boxes.

PART 2 P R O D U C T S

2.1 VALVE BOXES

A. Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.

B. Cast letter “W” into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.

C. Unless otherwise specified, uncoated cast iron.

D. Riser Pipe.

1. Provide 6-inch PVC, Class 150, DR 18, riser pipes in accordance with Division 33 or
2. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Division 33.
3. Provide single section of pipe.

E. Concrete for valve box placement:

1. For locations in new concrete pavement, provide strength and mix design of new pavement.
2. For other locations, provide concrete for sidewalks conforming to requirements of Division 32.

2.2 METER BOXES

A. Provide meter boxes as required by the governing authority and as shown on the drawings.

2.3 CAST-IRON METER BOXES

A. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.

B. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.

C. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

2.4 CONCRETE METER BOXES

A. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength, conforming to requirements of Division 32. Construct to dimensions shown on Drawings.

B. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

2.5 PLASTIC METER BOXES

A. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

ASTM	REQUIREMENT
D 256	Impact Strength = 1/9 ft.-lb./inch (Izod, Notched)
D 256	Impact Strength – 6.4 ft.-lb./inch (Izod, Un-Notched)
D 638	Tensile Strength (2.0 min.) = 3400 psi
D 648	Deflection Temperature = 170 degrees F
D 2240	Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb.
D 790	Flexural Modulus = 90,000 psi

B. Meter boxes shall meet the following test requirements:

1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.
3. Meter box body, without lid, shall weigh approximately 7 pounds.

2.6 METER VAULTS

A. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or common brick masonry unless a specific type of construction is required by Drawings.

B. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Division 32 with minimum compressive strength of 4000 psi at 28 days.

C. Reinforcing steel for meter vaults: Conform to requirements of Division 32.

D. Grates and Covers: Conform to requirements of Division 33.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Obtain approval from Owner’s Representative for location of meter vault.

B. Verify lines and grade are correct.

C. Verify compacted subgrade will support loads imposed by vaults.

3.2 VALVE BOXES

A. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.

1. Install with bell on top of valve.
2. Place riser pipe in plumb, vertical position.

B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.

C. Set, align, and adjust valve box so that lid is level with final grade.

D. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Owner, repaint covers black.

3.3 METER BOXES

A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.

B. Construct concrete meter boxes to dimensions shown on Drawings.

C. Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults.

D. Do not locate under paved areas unless approved by Owner's Representative. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

3.4 METER VAULTS

A. Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.

B. Precast Meter Vaults:

1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Division 31.
2. Seal lifting holes with cement-sand mortar or non-shrink grout.

C. Meter Vault Floor Slab:

1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.

2. Precast floor slab elements may be used for precast vault construction.

D. Cast-in-Place Meter Vault Walls:

1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.
2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
3. Set frame for cover in concrete.

3.5 FRAME AND COVER FOR METER VAULTS

A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:

1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.
2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch.

3.6 BACKFILL

A. Provide bank run sand in accordance with Division 31 and backfill and compact in accordance with Division 31.

B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1-to-5 slope from top to natural grade.

C. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

END OF SECTION 33 12 40

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SECTION 33 13 00

DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Disinfection of potable water lines.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for disinfection of water lines under this Section. Include cost in unit price of water lines being disinfected.
2. Refer to Division 1 for unit price procedures.

B. Adjusting Payment for Retesting.

1. Subsequent disinfection operations which may be necessary due to nonconforming or incomplete construction will be charged to Contractor. Charges will be deducted from retainage amounts when construction estimates are processed for final payment.
2. Total charge will consist of base charge of $135.00 plus footage charge based on number of feet of specified diameter pipe in construction project. Footage charge is as follows:

Size of Pipe	Charge per Linear Foot
2 inch to 4 inch	$0.03
6 inch	$0.04
8 inch	$0.05
10 inch to 12 inch	$0.07
16 inch to 20 inch	$0.09
24 inch to 30 inch	$0.13
32 inch to 48 inch	$0.16
54 inch	$0.20
60 inch	$0.22
66 inch	$0.31
72 inch to 84 inch	$0.40
90 inch to 96 inch	$0.58
108 inch	$0.75
120 inch or larger	$1.00

C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AWWA C 651 - Standard for Disinfecting Water Mains.

PART 2 P R O D U C T S -Not Used

PART 3 E X E C U T I O N

3.1 CONDUCTING DISINFECTION

A. Promptly disinfect water lines constructed before tests are conducted on water lines and before water lines are connected to Public water distribution system.

B. Contractor shall provide water for disinfection at no additional charge to the Owner.

C. Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations.

D. Coordinate chlorination operations through Owner's Representative.

3.2 PREPARATION

A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines prior to connection to Public water distribution system. Normally, each valved section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.

B. Use fire hydrants as blow-offs to flush newly constructed water lines 8 inch diameters and above. Where fire hydrants are not available on water lines, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.

C. Slowly fill each section of pipe with water in manner approved by Owner's Representative. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

D. Backfill excavations immediately after installation of risers or blow-offs.

E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.

3.3 DISINFECTION BY CONTRACTOR

A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:

1. Use not less than 100 parts of chlorine per million parts of water.
2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
4. Open and close valves in lines being sterilized several times during contact period.
5. If chemical compound is used for sterilizing agent, place in pipes as directed by Owner's Representative.

3.4 BACTERIOLOGICAL TESTING

A. After disinfection and flushing of water lines, bacteriological tests will be performed by the governing agency or testing laboratory in accordance with Division 1. When test results indicate need for additional disinfection of water lines based upon Texas Department of

Health requirements, assist Contractor shall provide additional disinfection operations at no additional cost to the Owner.

3.5 COMPLETION

A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION 33 13 00

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SECTION 33 13 00.10

HYDROSTATIC TESTING OF PIPELINES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Field hydrostatic testing of newly installed water pipelines.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.
   1. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.
   2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 P R O D U C T S – Not Used

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Disinfect water system pipelines prior to hydrostatic testing.

B. Hydrostatically test newly installed water pipelines after disinfection, when required, and before connecting to Public water distribution system.

C. Water for testing will be charged to Contractor in accordance with applicable Ordinances. Prior to hydrostatic testing, obtain a transient meter from the appropriate governing authority. Contractor shall pay all fees associated with transient meter.

D. Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.

E. Conduct hydrostatic tests in presence of Owner's Representative.

3.2 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.

B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.

C. For small diameter pipelines, expel air and apply minimum test pressure of 125 psi. For large diameter water lines, expel air and apply minimum test pressure of 150 psi.

D. Begin test by 9:00 a.m. unless otherwise approved by Owner's Representative. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.

E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.3 ALLOWABLE LEAKAGE FOR WATERLINES

A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.

B. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.

C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Owner's Representative for leakage during pressure test may be used to fulfill requirements of this section.

3.4 CORRECTION FOR FAILED TESTS

A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.

B. Owner's Representative may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Division 33. Pay for water required for additional disinfection and retesting.

C. Repeat test until satisfactory results are obtained.

3.5 COMPLETION

A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION 33 13 00.10

SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Gravity sanitary sewers and appurtenances, including stacks and service connections.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for gravity sanitary sewers by open-cut or within Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis, complete in place, including sewer pipe, connections to existing manholes, post installation television inspection and testing. Measurement will be taken along centerline of pipe from centerline to centerline of manholes.
2. Payment for television inspection of existing gravity sanitary sewer will be on a linear foot basis. Measurement will be taken along centerline of pipe from centerline to centerline of manholes. See Division 1.
3. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Owner.

1.4 QUALITY ASSURANCE

A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Division 33.

B. Regulatory Requirements.

1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
2. Make notification to Owner’s Representative when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
3. Lay gravity sewer lines in straight alignment and grade.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Inspect pipe and fittings upon arrival of materials at job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

PART 2 P R O D U C T S

2.1 PIPE

A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.

B. Reinforced concrete pipes are not acceptable.

2.2 PIPE MATERIAL SCHEDULE

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in Division 33.

B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.3 APPURTENANCES

A. Stacks. Conform to requirements of Division 33.

B. Service Connections. Conform to requirements of Division 33.

C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

2.4 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill: Conform to requirements of Division 31.

B. Topsoil: Conform to requirements of Division 32.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Division 1.

B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights where work is in progress or where traffic is affected by work.

C. Perform work in accordance with OSHA standards. Employ trench safety system as specified in Division 31 for excavations over 5 feet deep.

D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency or utility company for repairs or relocations, either temporary or permanent.

E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Division 2.

F. Install and operate dewatering and surface water control measures in accordance with Division 1.

G. Do not allow sand, debris or runoff to enter sewer system.

3.2 DIVERSION PUMPING

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.

B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into area outside of sanitary sewer.

D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to Texas Natural Resources Conservation Commission and Environmental Protection Agency by Owner's Representative.

3.3 EXCAVATION

A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.

C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Division 31.

3.4 PIPE INSTALLATION BY OPEN CUT

A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.

B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Owner's Representative.

C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.

E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Owner's Representative.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.

K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.

L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

3.5 PIPE INSTALLATION OTHER THAN OPEN CUT

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

3.6 INSTALLATION OF APPURTENANCES

A. Service Connections. Install service connections to conform to requirements of Division 33.

B. Stacks. Construct stacks to conform to requirements of Division 33.

C. Construct manholes to conform to requirements of Division 33 as applicable. Install frames, rings, and covers to conform to requirements of Division 33.

3.7 INSPECTION AND TESTING

A. Visual Inspection: Check pipe alignment in accordance with Division 33.

B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Division 33.

C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Division 33. Maintain piezometer installed to conform with Division 1until acceptance testing is completed.

3.8 BACKFILL AND SITE CLEANUP

A. Backfill and compact soil in accordance with Division 31.

B. Backfill trench in specified lifts only after pipe installation is approved by Owner's Representative.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Division 32.

D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and apply hydromulch according to requirements of Division 32.

E. Provide sodding in areas of residential land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and sod disturbed areas in accordance with Division 32.

3.9 POST-INSTALLATION TELEVISION INSPECTION

A. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.

B. Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.

C. Perform television inspection of gravity sanitary sewers as follows:

1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.
3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.

D. Provide video tapes on CD in a format compatible with Windows Media Player. Two labels are required. Place one label on the case and the other on the face of each CD. Permanently label each video tape with the following information.

Face of CD

Wastewater File No.: _____ Contractor's Name: _____
Inspection Type: [ ] Survey [ ] Pre-Installation [ ] Post-Installation
Tape No.: _____ Date Televised: _____ Date Submitted: _____
Basin No.: _____

CD Case

Manhole No. From	Manhole No. To	Pipe Diameter	Pipe Length	Street

E. For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.

F. Upon completion of video tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

END OF SECTION 33 31 00

SECTION 33 31 00.10

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Acceptance testing of sanitary sewers including:

1. Visual inspection of sewer pipes.
2. Mandrel testing for flexible sewer pipes.
3. Leakage testing of sewer pipes.
4. Leakage testing of manholes.
5. Smoke testing of point repairs.
6. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
2. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.

B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.

B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.

C. Maximum allowable leakage for Infiltration or Exfiltration.

1. The total exfiltration, as determined by hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at minimum test head of 2 feet above crown of pipe at upstream manhole or 2 feet above groundwater elevation, whichever is greater.
2. When pipes are installed more than 2 feet below groundwater level, use infiltration test in lieu of exfiltration test. Total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.
3. Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.

D. Perform air testing in accordance with requirements of this Section and Texas Natural Resources Conservation Commission requirements. Refer to Table 33 31 00.10-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test, and Table 33 31 00.10-4, Vacuum Test Time Table, at end of this Section.

1.5 SUBMITTALS

A. Conform to requirements of Division 1.

B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Owner's Representative. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.6 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports and video tape of television inspection as directed by Owner's Representative.

C. Upon completion of tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

1.7 SEQUENCING AND SCHEDULING

A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.

B. Coordinate testing schedules with Owner's Representative. Perform testing under observation of Owner's Representative.

PART 2 P R O D U C T S

2.1 DEFLECTION MANDREL

A. Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe,

dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.

C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 30 31 00.10-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Owner's Representative.

2.2 EXFILTRATION TEST

A. Water Meter: Obtain transient water meter from appropriate governmental agency for use when water for testing will be taken from public system. Conform to governmental agency requirements for water meter use.

B. Test Equipment:

1. Pipe plugs.
2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

2.3 INFILTRATION TEST

A. Test Equipment:

1. Calibrated 90 degree V-notch weir.
2. Pipe plugs.

2.4 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel.
2. Low-pressure air supply connected to control panel.
3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
4. Air hoses from control panel to:
   a. Air supply.
   b. Pneumatic plugs.
   c. Sealed line for pressuring.
   d. Sealed line for monitoring internal pressure.

B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

2.5 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.6 SMOKE TESTING

A. Equipment:

1. Pneumatic plugs.
2. Smoke generator as supplied by Superior Signal Company, or approved equal.
3. Blowers producing 2500 scfm minimum.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Division 1.

3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.

B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.
2. Plug sewer in downstream manhole.
3. Plug incoming pipes in upstream manhole.
4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.
5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 33 31 00.10-1 at end of this Section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.
2. Plug incoming pipes in upstream manhole.
3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
4. Allow water to rise and flow over weir until it stabilizes.
5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 33 31 00.10-1 at end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 33 01 30-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.
2. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.
3. For pipe sections less than 36-inch average inside diameter:
    a. Determine ground water level.
    b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
    c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
    d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 33 31 00.10-2 at end of this Section.

e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 33 31 00.10-2 at end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.

F. Retest: Repair and retest any section of pipe which fails to meet requirements.

3.5 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of this Section.

B. Low Pressure Air Test:

1. Times in Table 33 31 00.10-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Natural Resources and Conservation Commission (TNRCC) Design Criteria 317.2(a)(4)(B).

		T = 0.0850(D)(K)/(Q)
Where:	T =	Time for pressure to drop 1.0 pounds per square inch gauge in seconds
	K =	0.000419 DL, 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, 0.0015 ft^3/min./sq. ft. internal surface

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test.

Notes:
1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.6 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.

C. Vacuum testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 33 31 00.10-4, Vacuum Test Time Table.
3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Perform hydrostatic exfiltration testing as follows:

1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS

A. Application: Perform smoke test to:

1. Locate points of line failure for point repair.
2. Determine when point repairs are properly made.
3. Determine when service connections have been reconnected to rehabilitated sewer.
4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.

C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to Police and Fire Departments 24 hours prior to actual smoke testing.

D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.

E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Owner’s Representative.
2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.

F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Owner’s Representative.

G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

Table 33 31 00.10-1

WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	INCH	GALLONS	PIPE SIZE IN INCHES	GALLONS/MINUTE PER 100 FEET
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	13	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain.

Table 33 31 00.10-2
ACCEPTANCE TESTING FOR SANITARY SEWERS

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG														
Pipe Diam. (in.)	**Min. Time**	**Length For Min. Time (ft)**	**Time for Longer Length (sec)**	**Specification Time for Length (L) Shown (min:sec)**										
				100 ft	**150 ft**	**200 ft**	**250 ft**	**300 ft**	**350 ft**	**400 ft**	**450 ft**	**500 ft**	**550 ft**	**600 ft**
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	35:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64.38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

Table 33 31 00.10-3
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

Pipe Diameter (inches)	Minimum Time (seconds)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

Table 33 31 00.10-4
VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48”	60”	72”
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
*	5.0	6.5	8.0
*Add T times for each additional 2-foot depth. (The values listed above have been extrapolated from ASTM C 924-85)			

Table 33 31 00.10-5
PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average I.D. (Inches	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass (Class SN 46)	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
	54	54.82	52.079
	60	60.38	57.361

END OF SECTION 33 31 00.10

SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for storm sewers, including elliptical or box, installed by open-cut, augered with or without casing, or tunneling is on linear foot basis. Measurement for storm sewers and roadside ditch culverts will be taken along center line of pipe from center line to center line of manholes or from end to end of culverts. Payment will be made for each linear foot installed complete in place, including connections to existing manholes and inlets.
2. Payment for storm sewer leads, including elliptical leads, is on a linear foot basis.
3. Payment for corrugated metal pipe storm sewer outfall, including timber bents, is on a linear foot basis.
4. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.4 QUALITY ASSURANCE

A. The Condition for acceptance shall be watertight storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.

B. Provide manufacturer's certification to Specifications.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations.

B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Do not use Materials cracked, gouged, chipped, dented, or otherwise damaged shall not be use materials for installation.

C. Store pipe and fittings on heavy timbers or platforms to avoid contact with ground.

D. Unload pipe, fittings, and appurtenances as close as practical to location of installation to avoid unnecessary handling.

E. Keep interiors of pipe and fittings free of dirt and foreign matter.

F. Store PVC pipe out of direct sunlight.

PART 2 P R O D U C T S

2.1 PIPE

A. Provide piping materials for storm sewers shall be of sizes and types specified unless otherwise indicated on Drawings.

B. In diameters where material alternatives are available, provide pipe from single manufacturer for each pipe diameter, unless otherwise approved by Owner's Representative or otherwise shown on Drawings.

C. Existing pipe that has been removed during construction cannot be reused.

2.2 PIPE MATERIAL SCHEDULE

A. Storm Sewer Pipe: Use pipe materials that conforming to requirements specified in Division 33 and as shown on the Drawings.

B. Driveway Culvert Pipe for Streets with Open Ditches: Use pipe materials that conforming to requirements specified Division 33 and as shown on the Drawings.

C. Provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

D. Pipe materials other than those listed above shall not be used for storm sewers.

2.3 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill Material: Conform to requirements of Division 31.

B. Topsoil: Conform to requirements of Division 32.

C. Use cement stabilized sand material for bedding and backfill in the pipe zone for all storm sewers.

PART 3 E X E C U T I O N

3.1 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affects traffic. Conform to requirements of Division 1.

B. Provide barricades, flashing warning lights, and signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections while Work is in progress or where traffic is affected by Work.

C. Immediately notify agency or company owning utility lines which are damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for repairs or relocations, either temporary or permanent.

D. Remove old pavements and structures, including sidewalks and driveways in accordance with requirements of Division 2.

E. Install and operate dewatering and surface water control measures in accordance with Division 1.

3.2 EXCAVATION

A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of Work. Or use of appropriately sized grade boards which are substantially supported.

C. Trench Excavation. Excavate pipe trenches to level as indicated on Standard Details. Backfill excavation with specified bedding material to level of lower one-third of pipe barrel. Tamp and compact backfill to provide bedding at indicated grade. Form bedding foundation to minimum depth of one-eighth of pipe diameter, but not less than 6 inches.

3.3 PIPE INSTALLATION

A. Install in accordance with pipe manufacturer's recommendations and as specified in this section.

B. Install pipe only after excavation is completed, bottom of trench is shaped, bedding material is installed, and trench has been approved by Owner's Representative.

C. Install pipe to line and grade indicated on Drawings. Place pipe so that it has continuous bearing of barrel on bedding material with no voids, and is laid in trench so interior surfaces of pipe follows grades and alignments indicated.

D. Install pipe with bells of pipe facing upstream of anticipated flow.

E. Form concentric joint with each section of adjoining pipe to prevent offsets.

F. Place and drive home newly laid sections with a sling or come-a-long winches to eliminate damage to sections. Unless otherwise approved by Owner's Representative, provide end protection to prevent damage while using back hoes or similar powered equipment to drive home newly laid sections.

G. Keep interior of pipe clean as installation progresses.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with pipe plug specifically designed to prevent foreign material from entering pipe.

J. For PVC Pipe:

1. Provide a minimum cover as per manufacturer’s requirements from top of pavement to top of pipe, but no less than 2 feet.
2. Accomplish transitions to different material of pipe in a manhole or inlet box. No adapter, coupling for dissimilar pipe, or saddle connections allowed.
3. Provide pipe sections in standard lengths with minimum length of 13 feet. Pipe may be field modified to shorten length no less than 4 feet, unless otherwise approved by Owner’s Representative. Field modify pipe per manufacturer's recommendations.
4. No beveling at joint allowed. Cut to be perpendicular to longitudinal axis.
5. Provide gasketed bell and spigot joints installed per manufacturer's recommendations. Gasketed pipe joints; clean and free of debris, show no leakage after installation.

3.4 PIPE INSTALLATION OTHER THAN OPEN CUT

A. Conform to requirements of Division 33 where required.

B. Not allowed for plastic sewer pipe.

3.5 INSTALLATION OF APPURTENANCES

A. Construct manholes to conform to requirements of Division 33. Install frames, grate rings, and covers to conform to requirements of Division 33.

B. Install PVC pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars.

C. Install inlets, headwalls, and wingwalls to conform to requirements of Division 33.

D. Rehabilitate existing manholes to conform to requirements of Division 33. Adjust manhole covers and inlets to grade conforming to requirements of Division 33.

E. Dimension for Type C and Type E manholes shall be as shown on Drawings.

3.6 INSPECTION AND TESTING

A. Perform post installation television inspection in accordance with Division 33. Hand held cameras may be used in storm sewers in lieu of requirements Division 33. Clearly stencil distance markings on each joint of pipe to indicate distance from starting manhole when using hand held cameras.

3.7 BACKFILL AND SITE CLEANUP

A. Backfill trench after pipe installation is inspected and approved by Owner’s Representative.

B. Backfill and compact soil in accordance with Division 31.

C. Repair and replace removed or damaged pavement and sidewalks as specified in Division 32.

D. In unpaved areas, grade surface as uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and seed according to requirements of Division 32 as required.

END OF SECTION 33 41 00

SECTION 33 49 13

STORM DRAINAGE MANHOLES, FRAMES AND COVERS

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.

B. Ring grates.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No payment will be made for frames, grates, rings, covers, and seals under this Section. Include payment in unit price for related item.
2. Payment to rack over existing manhole is on a unit price basis for each manhole.
3. Refer to Division 1 for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

A. AASHTO -American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges

B. ASTM A 48 -Standard Specification for Gray Iron Castings

C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

D. AWS -D 12.1 Welding Reinforcing Steel.

1.4 SUBMITTALS

A. Conform to requirements of Division 1.

B. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.

C. Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings or standard City details. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 P R O D U C T S

2.1 CASTINGS

A. Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers if indicated on Drawings.

B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.

C. Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter.

D. Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

2.2 BEARING SURFACES

A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for position in which casting may be seated in frame.

2.3 SPECIAL FRAMES AND COVERS

A. Where indicated on Drawings, provide watertight manhole frames and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.

B. Where shown on Drawing, provide manhole frames and covers with 48 inch diameter clear opening, with inner cover for 22 inch diameter clear opening. Provide approved inner cover with pattern shown on Drawings.

2.4 FINISH

A. Unless otherwise specified, uncoated cast iron.

2.5 FABRICATED RING GRATE

A. Fabricate ring grates from reinforcing steel conforming to ASTM A 615.

B. Conform to welds connecting bars to AWS D 12.1.

2.6 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS

A. Use castings conforming to Division 33 requirements.

B. One piece casting with dimensions to fit frame and cover.

PART 3 E X E C U T I O N

3.1 INSTALLATION

A. Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer's printed materials.

B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.

C. Fabricate ring grates in accordance with City of Houston standard detail, "Ring Grate for Open End of 18 Inch to 72 Inch Stubs to Ditch". Set in mortar in mouth of pipe bell.

D. Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

END OF SECTION 33 49 13

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