

Project Manual

for

Tomball HS Athletic Improvements –

DIG Project No.: 250515

for the

TOMBALL INDEPENDENT SCHOOL DISTRICT

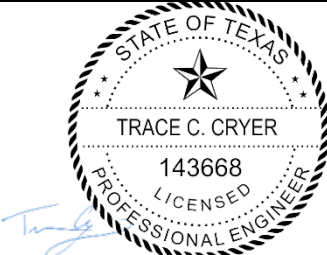
10 September 2026

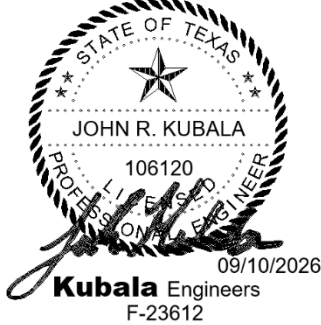
Issue for Proposal

Texas Registered Engineering Firm F-18379

Issue for Proposal

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

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 PROJECT INFORMATION

- A. Project Identification: Tomball High School
30330 Quinn Road, Tomball, Texas 77375
- B. Owner: Tomball Independent School District
 - 1. 310 S. Cherry Street, Tomball, Texas 77375
- C. Owner: Tomball Independent School District
 - 1. Owner's Representative: Victor Fleming
Project Manager
- D. Architect: DIG Engineers
- E. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following: Improvements to the Tomball HS Athletic Complex including site lighting upgrades to the football field, baseball and softball fields and the tennis courts. New padding and back tensioned backstop netting at the baseball and softball fields, including removing the existing padding and net system. Proposed bleacher system with pre-engineered press box, sidewalks to address accessibility, restroom additions to accommodate the increase in total occupancy. Tennis courts are recoated. A new front entry to the athletic complex consisting of masonry walls and wrought iron gates to match the existing facade.
- B. Type of Contract: Project will be constructed under competitive sealed proposal (CSP) contract.

1.5.1 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

- C. Cooperate fully with Owner so Work may be carried out smoothly, without interfering with or delaying the work or work by Owner. Coordinate the Work with Work performed by Owner.
- D. The Owner reserves the right to let separate contract for Work outside of the scope of this Contract. Cooperate fully with separate contractors so Work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with Work performed under separate contracts.
- E. Purchase Contracts: The Owner reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. The Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
 - 1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.
- F. Owner Furnished, Contractor Installed Products (OFCI): The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable.
 - 1. Owner Furnished Products: Coordinate with Owner.

1.5 ACCESS TO SITE

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

1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform Work to prevent interference with Owner's day to day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided occupancy does not interfere with completion of

the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. Upon occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.7 WORK RESTRICTIONS

- A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two weeks in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on site.
 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

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

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

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

- A. The Owner has a critical need for the Work, and all project components will be substantially complete by July 31, 2027. There will be No Extensions of Time due to weather.

END OF SECTION 01 10 00

SECTION 01 21 00 – ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include
 - 1. Lump sum allowances.
 - 2. Unit cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.

1.3 COORDINATION

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

1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES

- A. Use the lump sum, unit cost, and quantity allowances only as directed by Architect for Owner's purposes and only by executed Change Proposal Requests and Allowance Expenditure Authorizations that indicate amounts to be charged to the allowance.
- B. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include freight and delivery to site.
- C. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- D. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.
- E. If requested by Architect and Owner, transfer unused amounts remaining in lump sum, unit cost, and quantity allowances to the Owners Contingency Allowance. Otherwise, credit unused amounts remaining in the lump sum, unit cost, and quantity allowances to Owner by Change Order.

1.5 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by executed Change Proposal Requests and Allowance Expenditure Authorizations that indicate amounts to be charged to the allowance.
- B. Contractor's related costs for work ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, equipment rental, and similar costs directly attributable to the work completed under the allowance. Contractor general conditions, profit and overhead shall be included as part of the Contract Sum and not part of the allowance.
- C. Change Proposal Requests and Allowance Expenditure Authorizations authorizing use of funds from the contingency allowance will include Contractor's related costs. Contractor general conditions, overhead and profit on Contingency Allowances shall be included as part of the Contract Sum and not part of the allowance.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 ADJUSTMENT OF ALLOWANCES

- A. Allowances will be adjusted by an executed Allowance Expenditure Authorization based upon executed Change Proposal Requests. Work to be completed under allowances may proceed after an Owner executed Change Proposal Request has been received by the Contractor. Work funded by allowances may be included on an application for payment only after an Owner executed Allowance Expenditure Authorization has been received by the Contractor.
- B. Upon receipt of an Owner executed Allowance Expenditure Authorization, transfer unused lump sum, unit cost and quantity allowance funds to the Owners contingency allowance. Upon receipt of an Owner executed Allowance Expenditure Authorization, transfer all other unused allowance amounts to the Owners contingency allowance.
- C. At Project closeout, credit unused amounts remaining in Owners contingency allowance to Owner by Change Order.
- D. Change Orders to increase or add allowances to the project will include Contractor's reasonable costs including delivery, installation, equipment rental and other related costs. Reasonable Contractor general conditions costs, reasonable Contractor profit and overhead (in accordance with Section CB) will be included in the Change Order.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.
- B. All work completed under allowances shall be executed in accordance with the requirements of the Contract documents.

3.3 SCHEDULE OF ALLOWANCES

Owner's Contingency Allowance: \$300,000.00

- 1. Contractor shall include the amount indicated in the **Base Quote** as a contingency to cover the cost of hidden, concealed, or otherwise unforeseen conditions and for other costs as directed by the Owner which develop during the completion of the work. Contractor shall be allowed to recover costs associated with the completion of work under the contingency; Contractor general conditions, overhead and profit should be included in the Base Proposal and is not part of the allowance.

Owner's Contingency for Memorial Wall: \$100,000.00

- 2. Contractor shall include the amount indicated in **Alternate 01** as a contingency to cover the cost of creating a memorial to honor the athletic accomplishments as directed by the Owner which will develop during the completion of the work. Contractor shall be allowed to recover costs associated with the completion of work under the contingency; Contractor general conditions, overhead and profit should be included in the Base Proposal and is not part of the allowance.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

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

3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- B. Unit Price No. 2: Cutting and patching of concrete floor slabs.
 1. Description: Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents.
 2. Unit of Measurement: Square feet of concrete removed. Cost shall include all materials, labor, overhead and profit for complete installation of concrete floor slab.
- C. Unit Price No. 3: Cement Stabilized Sand and Lean Concrete
 1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for the complete installation of cement stabilized sand and lean concrete. Enter unit cost on Proposal form.
- D. Unit Price No. 4: Select Fill
 1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation of select fill. Enter unit cost on Proposal Form.
- E. Unit Price No. 5: Flowable Fill
 1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of flowable fill or controlled low-strength material (CLSM), delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation. Enter unit cost on Proposal Form.
- F. Unit Price No. 6: Concrete
 1. Description: This unit price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new concrete material, delivery, labor for installation/ placement, formwork, etc per plans and specs. Reinforcement for concrete shall also be included and shall be assumed to be 2% minimum by volume. Enter unit cost on Proposal Form.
- G. Unit Price No. 7: Grade Beam (Add)
 1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam. Enter unit cost for each grade beam size on Proposal Form.
- H. Unit Price No. 8: Grade Beam (Deduct)
 1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam. Enter unit cost for each grade beam size on Proposal Form.
- I. Unit Price No. 9: Miscellaneous and structural steel
 1. Description: Miscellaneous lintels and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications." This unit price shall be the entire unit cost including overhead and profit for one (1) pound of fabricated steel as indicated on the itemized invoice of steel supplier and verified by the Architect. Cost shall include all materials, labor,

detailing, engineering, erection, overhead and profit for complete installation. Enter unit cost on the Proposal Form.

- J. Unit Price No. 10: Existing Pier Demo Condition 1 (Overlap With New Pier)
1. Description: At any location where a new pier will overlap an existing footing/pier, the soil currently in the existing footing/pier shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size
- K. Unit Price No. 11: Existing Pier Demo Condition 2 (No Conflict with New Piers)
1. Description: At any location where an existing footing/pier does not overlap with a new pier, the portion of the existing footing/pier within 5 ft of the bottom of the future slab shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698). The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size.
- L. Unit Price No. 12: Spread Footings (Add)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) spread footing of each footing size utilized in the project per the footing schedule in the S-300 series. Cost shall include all materials, labor, detailing, overhead and profit for complete installation. Enter unit cost for each spread footing size on Proposal Form.
- M. Unit Price No. 13: Spread Footings (Deduct)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) spread footing of each footing size utilized in the project per the footing schedule in the S-300 series. Cost shall include all materials, labor, detailing, overhead and profit for complete installation. Enter unit cost for each footing size on Proposal Form.

END OF SECTION 01 22 00

SECTION 01 23 00 – ALTERNATES

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent Work as necessary to completely integrate Work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Forty-eight (48) hours following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other Work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1 – Front Entry Upgrades:

This Alternate shall establish the amount to add to the Base Proposal for the cost of adding front entry upgrades, please reference sheet AS-601, for installation complete in place.

B. Alternate No. 2 – New Tennis Court Lights

This Alternate shall establish the amount to add to the Base Proposal for the cost of demoing the existing tennis court lights and installing new MUSCO poles and fixtures, for installation.

C. Alternate No. 3 – Fiber for Press Boxes

This Alternate shall establish the amount to add to the Base Proposal for the cost of adding optic fiber to the baseball and softball press boxes, for installation.

D. Alternate No. 4 – Restroom Building

This Alternate shall establish the amount to add to the Base Proposal for the cost of adding a restroom building to accommodate the increased capacity for installation.

E. Alternate No. 5 – Pedestrian Lighting

This Alternate shall establish the amount to add to the Base Proposal for the cost of repairing the existing electrical service to the pedestrian light poles.

END OF SECTION 01 23 00

SECTION 01 25 13

PRODUCT SUBSTITUTION PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specified product compliance, and product quality assurance
- B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.
- C. Requirements for product delivery, storage and handling.

1.2 RELATED REQUIREMENTS

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

1.3 DESCRIPTION OF REQUIREMENTS

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

1.4 PRODUCT QUALITY ASSURANCE

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

Architect/Engineer's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

- B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- C. Or Equal:
 - 1. Where the phrase "or equal", "or equivalent", "or Architects approved equal", or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
 - 2. The decision of the Architect shall be final.
- D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.
- E. Foreign Product Limitations: "Foreign products" as distinguished from "domestic products" are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
 - 1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
 - a. There is no domestic product available that complies with the requirements of the Contract Documents.
 - b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
 - c. At the discretion of the Architect or Owner.
 - 2. Final determination and acceptance will be the responsibility of the Architect.
- F. Standards: Refer to Section 01 41 00, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.5 SUBSTITUTIONS OF PRODUCTS

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

- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final
- E. The following are not considered as substitutions:
 - 1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as "changes" not substitutions.
 - 2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
 - 3. Except as otherwise provided in the Contract Documents, the Contractor's determination of and compliance with governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.
- F. The following may be considered as a reason for a request for substitution:
 - 1. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
 - 2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
 - 3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - 4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
 - 5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 - 6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 - 7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- G. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.

2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- H. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- I. **No substitutions will be considered after the Award of Contract.**

1.6 SUBSTITUTION REQUEST SUBMITTAL

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

subsequently become necessary because of the failure of the substitution to perform adequately.

8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.

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

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
 1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.
 2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
 3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
 5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

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

Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process.
- B. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
 1. Proprietary and Semi-Proprietary Specification Requirements:

- a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
 - b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.
4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by

established allowances, and for the procedures required for processing such selections.

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

2.2 SUBSTITUTIONS

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

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.
- B. Anchor each product securely in place, accurately located and aligned with other work.
- C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.
- D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

- A. Coordinate all approved substitutions with adjacent work.
- B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.
- C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Change procedures.
- B. Defect assessment.

1.2 GENERAL

- A. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning change procedures.

1.3 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Minor Changes: The Architect/Engineer may advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on Minor Change form or by other similar documents in the form issued by the Architect.
- C. Change Proposal Request: The Architect may issue a Change Proposal Request (CPR) or other similar request for proposal in the form issued by the Architect, including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate in the form of a Change Proposal so as to not cause delays in the Project.
- D. Use of allowances must be approved by issuance of Allowance Expenditure Authorization (AEA) by Architect prior to modification of the schedule of values. The AEA may be comprised of a single executed Change Proposal, an accumulation of executed Change Proposals, or other similar documentation in the form allowed by the Architect in accordance with Document CB, Supplementary Conditions of the Contract.
- E. Contractor may propose changes which, in his opinion, will provide value to the Owner, by submitting a request for change to Architect, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. If accepted by Architect and approved by Owner, submit a Change Order in accordance with the requirements of this Section. This request will not be considered a substitution except as defined by Section 01 25 13, Product Substitution Procedures. Owner is not obligated to accept this request.
- F. Construction Change Directive: Architect/Engineer may issue directive, on AIA Form G713 Construction Change Directive or other similar document in the form issued by the Architect, and signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in

the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

- G. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- H. Change Order Forms: AIA G701 - Change Order.
- I. Execution of Change Orders: The Architect will prepare and sign the Change Order, the contractor shall sign the Change Order indicating acceptance of the change, and then the Owner will execute the Change Order.
- J. Correlation Of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in Project Record Documents.

1.4 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements at no additional cost to the Owner.
- B. If, in the opinion of the Architect/Engineer or Owner, it is not practical to remove and replace the Work, the Architect will direct appropriate remedy or adjust payment.
- C. The defective Work may remain, but sum/price will be adjusted to new sum/price at the discretion of Architect or Owner.
- D. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- E. Authority of Architect/Engineer, or other appropriate agent identified to perform assessment by the Architect/Engineer or Owner, to assess defects and identify payment adjustments, is final.
- F. Non-Payment For Rejected Products: In addition to replacement of rejected Work, payment will not be made for rejected products for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
- B. Pencil Copy: A preliminary review copy of the application for payment for review by Architect and Owner prior to submission of final copy.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Updated Submittal schedule.
 - c. Items required to be indicated as separate activities in updated Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment. Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.

- 3) Equipment rentals.
- 4) General Conditions.
 - a. Supervisor.
 - b. Submittals.
 - c. Close-out.
 - d. Field Engineering.
 - e. Daily Clean-up.
 - f. Final Clean-Up.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on site and items stored off site. Include evidence of insurance.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. **Submit preliminary (pencil) copy of proposed values to Architect or Architects field representative and Owner for review by the 30th of each month. Allow 96 hours for comments.**
- B. Once preliminary (pencil) approved, submit one (1) electronic copy of notarized originals and four (4) notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.
- C. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- D. Submit updated construction or recovery schedule with each Application for Payment.
- E. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document CB, Supplementary Conditions of the Contract.
- F. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.
- G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
 1. Current Record Documents as specified in Section 01 77 00, Closeout Procedures maintained.
 2. Labor time sheets, purchase orders, or similar documentation.
 3. Affidavits attesting to off-site stored products.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 29 00

SECTION 01 29 73 - SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.
- B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.2 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.3 SUBMITTALS

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

1.4 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.
- B. Schedule of Values - Items in addition to Specification Sections.
 - 1. Mobilization
 - 2. Clean Up
 - 3. Building Permit
 - 4. Bonds, Insurance
 - 5. Misc. Mechanical Accessories
 - 6. Demolition
 - 7. Rough-In Labor - (Electrical)
 - 8. Rough-In Material - (Electrical)
 - 9. Finish Labor - (Electrical)
 - 10. Finish Material - (Electrical)
 - 11. Allowances (listed separately)
 - 12. Record drawings and close-out documents
 - 13. Submittals listed separately per mechanical, electrical and plumbing

- 14. Roof warranty as a line item
- 15. Donated items individually itemized at \$0.00 (zero dollars).

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Refer to following sample.

END OF SECTION

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 1 - General Reqs. Site Work General Conditions Supervision Mobilization Bonds & Insurance Permits Contractor's Fee Close-Out Documents								
	Div. 1 - Total								
	Div. 2 - Existing Conditions Demolition (As applicable) Erosion Control Div. 2 - Total								
	Div. 3 - Concrete Drill Piers Caps & Beams Slab on Grade Cooling Tower Basin Misc Bldg Conc Floor Sealer Rebar Matl Rebar Labor Lt.Wt.Insul Fill - Materials Lt.Wt.Insul Fill - Labor Submittals/Close-Out Documents Supervision Clean-up								
	Div. 3 - Total Div 4 - Masonry Brickwork - Labor Brickwork - Matls Concrete Masonry - Labor Concrete Masonry - Materials Str. Glazed Tile-Labor Str. Glazed Tile-Materials Submittals/Close-Out Documents Supervision Clean-up								
	Div. 4 - Total								
	Div 5 - Metals Structural Steel - Labor Structural Steel - Materials Alternating Stairs Misc. Steel - Materials Steel Joists - Materials Lt. Gauge Steel Framing-Labor Lt. Gauge Steel Framing-Matls Metal Decking - Labor Expansion Joint Covers Metal Decking - Matls								

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Detailing Submittals/Close-Out Documents Supervision Clean-up								
	Div. 5 - Total								
	Div. 6 - Wood & Plastics Rough Carpentry - Labor Rough Carpentry - Materials Millwork - Labor Millwork - Materials Submittals/Close-Out Documents								
	Div. 6 - Total								
	Div. 7 - Thermal and Moisture Protection Waterpfng / Dampprfng-Matls Waterpfng / Dampprfng-Labor Building Insulation - Labor Building Insulation - Materials Fireproofing - Labor Fireproofing - Materials Metal Roof - Labor Metal Roof - Materials Metal Roof Guarantee Built-up Roofing-Labor Built-up Roofing-Materials Built-up Roofing Guarantee Roof Accessories Building Sheet Metal - Labor Building Sheet Metal - Matls Bldg. Sheet Metal Guarantee Roof Curbs Roof Hatches Sealants Submittals/Close-Out Documents Supervision Clean-up								
	Div. 7 - Total								
	Div. 8 - Doors and Frames Finish Carpentry/Door - Labor Finish Hardware - Matls Thresholds & Seals - Matls+B66 Hollow Metal Doors & Frames - Matls Plastic Faced Doors-Matls Overhead Doors & Grilles-Labor Overhead Doors & Grilles - Matls Alum. Entrances & Store-fronts - Labor Alum. Entrances & Store-								

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	fronts - Matls Alum. Windows - Labor Alum Windows - Matls Glass & Glazing-Labor Glass & Glazing-Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 8 - Total								
	Div. 9 - Finishes Lath & Plaster-Labor Lath & Plaster-Matls Gypsum Wallboard Systems - Labor Gypsum Wallboard Systems - Matls Ceramic Tile - Labor Ceramic Tile - Matls Quarry Tile - Labor Quarry Tile - Matls Terrazzo-Labor Terrazzo-Matls Acoustic Clg. - Labor Acoustic Clg. - Matls Acoustic Wall Panels Resilient Flooring - Labor Resilient Flooring - Matls Carpet - Labor Carpet - Matls Athletic Flooring - Materials Athletic Flooring - Labor Floor Sealer Painting - Labor Painting - Mtls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 9 - Total								
	Div. 10 - Specialties Visual Display Boards & Tackboards - Materials Visual Display Boards & Tackboards - Labor Toilet Partitions - Labor Toilet Partitions - Matls Louvers Aluminum Flag Pole Graphics Lockers Cubicle Curtains & Track Fire Extinguisher Cabinets Demountable Partitions-Labor								

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Demountable Partitions-Matls Shelving Toilet Room Accessories-Matls Toilet Room Accessories-Lbr Submittals/Close-Out Documents Supervision Clean-up								
	Div. 10 - Total								
	Div. 11 - Equipment Stage Curtains Misc. Appliances Food Service Eqpt-Labor Food Service Eqpt-Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 11 - Total								
	Div. 12 - Furnishings Horizontal Blinds Projection Screens Casework - Labor Casework - Matls Science Casework - Labor Science Casework - Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 12 - Total								
	Div. 13 - Specialties Stage Curtains and Draperies Music Instrument Storage Bleachers Press Box Pre-eng. Metal Bldg. Stadium Seating Submittals/Close-Out Documents Supervision Clean-up								
	Div. 13 - Total								
	Div. 14 - Conveying Systems Platform Lifts Elevators Submittals/Close-Out Documents Supervision Clean-up								
	Div. 14 - Total								
	Div. 21, 22 - Plumbing Shop Drawings As-Builts/Close-Out/ O&M Manuals Sanitary Underground -								

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Labor Sanitary Underground - Matls Storm Underground - Labor Storm Underground - Matls Domestic Water - Labor Domestic Water - Matls Plumbing Insulation - Matls Plumbing Insulation - Labor Gas Piping - Matls Gas Piping - Labor Grease Trap Plumbing Fixtures - Matls Plumbing Fixtures - Labor Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 21, 22 Plumbing - Total								
	Div. 23 - Mechanical Shop Drawings As-Builts/Close-Out/ O&M Manuals Chillers - Matls Chillers - Labor Cooling Towers - Matls Cooling Towers - Labor Boilers - Matls Boilers - Labor AHU's - Matls AHU's - Labor Fans - Matls Fans - Labor Grilles - Matls Grilles - Labor Ductwork - Matls Ductwork - Labor Pumps - Mtls Pumps - Labor Water Treatment - Labor Water Treatment - Matls Isolation - Labor Isolation - Matls Pipe Flex - Matls Pipe Flex - Labor Connections Sheet Metal - Matls Sheet Metal - Labor Duct Insulation - Matls Duct Insulation - Labor								

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Pipe Insulation - Matls Pipe Insulation - Labor VAV Boxes - Materials VAV Boxes - Labor Refrigerant Monitor - Matls Refrigerant Monitor - Labor Unit Heaters - Materials Unit Heaters - Labor Startup Controls - Matls Control - Labor Engineer / Submittals Modules / End Devices Low Voltage Wiring Startup Close-Out Documents Fire Sprinkler Engineer / Submittals Piping - Materials Piping - Labor Equipment - Materials Equipment - Labor Trimout - Materials Trimout - Labor Pipe, Valves, Fittings - Labor Pipe, Valves, Fittings - Matls Misc. - Matls Insulation - Matls Insulation - Labor Sanitary Above Slab-Labor Sanitary Above Slab-Matls Storm Above Slab - Labor Storm Above Slab - Matls Gas - Labor Gas - Matls Fixtures - Labor Fixtures - Matls Permits Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 23 Mechanical - Total								
	Div. 26 - Electrical Mobilization+B220 Shop Drawings As-Builts/Close-Out/ O&M Manuals Underground Conduit - Labor Conduit - Matl Wire - Labor								

SECTION 01 29 73
SCHEDULE OF VALUES -SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Wire - Matls Feeder Wire - Labor Feeder Wire - Matls Switches/Recpt. Switchgear - Labor Switchgear - Matls Temporary - Materials Temporary - Labor Gas Generator - Materials Gas Generator - Labor Fixtures - Labor Fixtures - Matls Communications - Labor Communications - Matls Fire Alarm - Labor Fire Alarm - Matls Security - Labor Security - Matls Low Voltage Ltng Sys-Matls Low Voltage Ltng Sys-Labor Voice System - Materials Voice System - Labor Video System - Materials Video System - Labor Data System - Materials Data System - Labor Master Clock - Materials Master Clock - Labor+B277 Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 26 - Total								
	Divs. 31, 32 and 33 - Earthwork, Exterior Improvements and Utilities								
	Site Clearing & Grubbing Building Pad - Materials Building Pad - Labor Paving Subgrade Signage / Striping Bike Racks Landscaping - Materials Landscaping - Labor Hydro Mulch - Materials Hydro Mulch - Labor Irrigation - Materials Irrigation - Labor Earthwork Finish Grading Stabilization - Materials Stabilization - Labor Site Drainage - Materials Site Drainage - Labor								

SECTION 01 29 73
SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Chain Link Fence-Materials Chain Link Fence-Labor Paving - Labor Paving - Materials Sidewalks Submittals/Close-Out Documents Supervision Clean-up								
	Div. 31, 32 and 33 - Total								
	General Conditions Mobilization Temp. Facilities Final Cleaning Record Documents/Close-out/ O&M Manuals Supervision Permits Bonds Insurance Allowances Alternates (list) Change Orders A. PR# B. PR# C. PR#								

END OF SECTION

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Pre-install meetings.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.
- C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI's) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

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

- B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate Contractors if coordination of the Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
 - 9. Coordinating inspections and other jurisdictional requirements.
 - 10. Coordinate OFCI equipment.
 - 11. Action items and issue logs.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

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

- c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, ductwork, piping, and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - e. Floor boxes.
 8. Fire Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.
 9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio
 10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared

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

11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Revit.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

- A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
 4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
 5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.
- B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Meeting Agenda, may include, but is not limited to:
 - a. Discussion on major subcontracts and suppliers and projected construction schedules.
 - b. Critical work sequencing.
 - c. Major equipment deliveries and priorities. Discussion of long lead time items.
 - d. Project coordination and designation of responsible personnel.
 - e. Procedures and processing of field decisions, proposal requests, submittals, minor changes, change orders and applications for payment.
 - f. Method of distribution of Contract Documents.
 - g. Procedures for maintaining Record Documents.
 - h. Use of premises, office work and storage areas, on-site parking, and Owner's requirements.
 - i. Construction facilities and temporary utilities.
 - j. Housekeeping procedures.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- C. Preinstallation Conferences: Notify the Architect 48 hours in advance of certain stages of construction, and, as required by the Architect, organize a pre-installation meeting with each trade individually prior to commencement of their portion of the Work. At a minimum, representatives of the Architect, the General Contractor's project superintendent, and the Sub-contractor's Foreman and Project Manager shall be present at each meeting. The Engineer shall be notified as applicable
1. As indicated in each specific section of this Project Manual, or as required by the Architect, these stages generally include, but are not necessarily limited to the following:
 - a. Division 3 - Installation of light weight concrete.
 - b. 03 30 00 - Excavation of grade beams.
 - c. 03 30 00 - Installation of concrete underlayment, vapor barriers, underslab water proofing
 - d. 03 30 00 - Placing of reinforcing, formwork, and concrete.
 - e. Division 4 - Block, brick, and stone placement, glass unit masonry, masonry cleaning.
 - f. 04 20 00 - Placing of masonry, grout, and reinforcement.
 - g. Division 5 - Erection of structural steel, open web steel joists, and steel deck.
 - h. 05 50 00 - Miscellaneous metals, ladders, brackets, pipe rails, etc.
 - i. Division 6 - Finish Carpentry and Millwork
 - j. Division 7 - Installation of waterproofing, air barriers, vapor barriers, flashing and sheet metal.
 - k. Division 7 - Installation of roofing system(s) and associated work.
 - l. 07 21 00 - Concealment of insulation.
 - m. 07 81 00 - Application of fireproofing.
 - n. 07 84 00 - Installation of firestopping and fire safing.
 - o. 07 92 00 - Installation of building and glazing sealants.
 - p. Division 8 - Installation of doors, frames, windows, and storefronts.
 - q. Division 8 - Installation of rolling and coiling doors and grilles.
 - r. 08 71 00 - Installation of finish hardware
 - s. 08 80 00 - Installation of glazing and glazed systems
 - t. Division 9 - Installation of plaster and gypsum board products.
 - u. Division 9 - Installation of tile, flooring, and pavers.
 - v. 09 51 00 - Installation of acoustical ceiling (grid and panels).
 - w. 09 65 19 - Installation of resilient flooring and base.
 - x. 09 72 16 - Installation of wall coverings
 - y. 09 91 00 - Painting and staining (each coat).
 - z. Division 10 - Installation of specialty items, markerboards, display cases, projection screens, signage and graphics, canopies.
 - aa. Division 10 - Installation of operable walls and folding partitions.
 - bb. 10 28 13 - Installation of toilet accessories.
 - cc. Division 11 - Installation of appliances, stage curtain systems, library shelving, and shop equipment
 - dd. Division 11 - Installation of gymnasium equipment, scoreboards, and outdoor athletic equipment
 - ee. Division 12 - Installation of educational and laboratory casework, and library furniture.
 - ff. Division 12 - Installation of theater seating and bleachers.
 - gg. 12 35 00.11 - Installation of musical instrument storage.
 - hh. Division 13 - Specialty construction items, swimming pools, metal buildings.
 - ii. Division 14 - Installation of elevators, platforms and lifts.
 - jj. Divisions 22, 23 and 26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).

- kk. Division 22 - Installation of plumbing fixtures.
- ll. Division 23 - Installation of heating, ventilating and air conditioning.
- mm. Division 26 - Installation of all electrical fixtures.
- nn. Divisions 22, 23 and 26 - Any and all testing specified for equipment, mechanical, electrical and plumbing systems.
- oo. 31 00 00 - Clearing and stripping of top soil within limits of grading.
- pp. 31 00 00 - (Excavation and) Placing (of each lift of) select fill material, and site grading.
- qq. 31 00 00, 31 23 23.13, and Divisions 22, 23 and 26 - Compaction, inspection, testing, and covering of underground utilities.
- rr. 31 63 29 - Drilling foundation piers.
- ss. Division 32 - Installation of site amenities, fencing, surfaces, landscaping, etc.
- 2. Attendance, optional:
 - a. General Contractor or Contractor's Representative
 - b. Project Coordinator (Manager)
 - c. Owner or Owner's Representative
 - d. Architect's Project Manager (Project Executive)
- 3. Attendance, required:
 - a. Project Superintendent
 - b. Architect's Field Representative
 - c. Sub-contractor's Project Manager
 - d. Sub-contractor's Foreman
 - e. Engineer's Representative, as needed.
 - f. Manufacturer's Representative, as needed.
 - g. Governing Agency Official, as required
 - h. Inspection Agency Representative, as required.
 - i. Others affecting or affected by Work.
- 4. Meeting Agenda, may include, but is not limited to:
 - a. Review of conditions of installation.
 - b. Preparation and installation procedures.
 - c. Coordination with related work
 - d. Review of the contract document requirements.
 - e. Review of code enforcement or testing requirements.
 - f. Questions related to work required.
- 5. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- 6. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.
- 7. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- 8. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- 9. In addition to notifying the Architect, notify the Structural Engineer (48 hours) prior to the following stages:
 - a. Drilling, reinforcing, and placing of first piers and footings.
 - b. Placing first reinforcing and grade beams.
 - c. Erecting structural steel elements.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 180 days prior to the scheduled date of Substantial Completion.
 - 1. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
 - 2. Attendance, required:
 - a. Owner or Owner's Representative

- b. Project Coordinator (Manager)
 - c. General Contractor or Contractor's Representative
 - d. Project Superintendent
 - e. Architect's Project Manager (Project Executive)
 - f. Architect's Field Representative
 - g. Engineer's Representative, as needed.
 - 3. Meeting Agenda, may include, but is not limited to:
 - a. Review of the contract document requirements for Substantial Completion and Project Closeout
 - b. Review of Work which remains to be completed or corrected.
 - c. Closeout Document review schedule and log
 - d. Review of closeout procedures including, but not limited to Record Drawings, Warrantees, Operation and Maintenance Manuals, and Owner Demonstrations and Start-up.
 - e. Review of code enforcement or testing requirements.
 - f. Questions related to work required.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
 - 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Architect will:
 - 1. Schedule project meetings throughout progress of the work at weekly intervals, and specially called meetings.
 - 2. Set agenda and administer said meetings.
 - 3. Preside at meetings.
 - 4. Record meeting minutes, including all significant proceedings and decisions.
 - 5. Reproduce and distribute copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.
 - 2. Contractor shall:
 - a. Make physical arrangements for meetings.
 - 3. Attendance:
 - a. Contractor or Contractor's Representative
 - b. Job Superintendent
 - c. Project Coordinator (Manager)
 - d. Owner or Owner's Representative
 - e. Major subcontractors
 - f. Major suppliers
 - g. Architect's Field Representative
 - h. Consultants as needed
 - i. Others as appropriate
 - 4. Meeting Agenda, may include, but is not limited to:
 - a. Review and approval of minutes of previous meeting.
 - b. Review of Work progress since previous meeting.
 - c. Field observations, problems, and conflicts.
 - d. Review of off-site fabrication and delivery schedules.
 - e. Corrective measures and procedures to regain projected schedule.
 - f. Revisions to Construction Schedule.
 - g. Plan progress and schedule during succeeding work period.
 - h. Coordination of schedules.
 - i. Review submittal schedules and expedite as required.
 - j. Maintenance of quality standards.
 - k. Allowance balances.
 - l. Review of proposed changes and substitutions for:
 - i. Effect on Construction Schedule and on completion date.

- ii. Effect on other contracts of the Project.
 - m. Status of Allowance Expenditure Authorizations (AEAs).
 - n. Status of Change Proposal Requests (CPRs).
 - o. Status of Minor Changes (MCs).
 - p. Status of submittals, review of submittal log.
 - q. Other items and critical issues affecting Work.
 - 5. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
 - b. Six (6) week look-ahead schedules.
 - 6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each Contractor present.
 - 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
 - 4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 31 13

SECTION 01 31 19 - PROJECT MEETINGS

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDE

- A. The Architect's:
 - 1. Scheduling of each meeting (pre-construction meeting, periodic project meetings, and specialty called meetings throughout the progress of the Work).
 - 2. Preparation of agenda for meetings.
 - 3. Presiding at minutes, including all significant proceedings and decisions.
 - 4. Recording, reproducing, and distributing copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.
 - 5. Providing status report of allowance funds.
- B. The Contractor's:
 - 1. Making physical arrangement for meetings.
 - 2. Participation in all meetings and conferences.
 - 3. Scheduling attendance of Job Superintendent, Project Coordinator, and other parties affecting or affected by decisions made at meetings and conferences as their interests require.
 - 4. Scheduling Pre-installation conferences.
 - 5. Scheduling Pre-Closeout Meeting
 - 6. Providing updated schedules.
 - 7. Providing status reports/logs of CPRs, MCs, and shop drawings/submittals.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.
- B. Architect will:
 - 1. Administer pre-construction conference for the establishment of communication methods, procedures and Owner requirements.
 - 2. Administer site mobilization conference for clarification of Owner and Contractor.
- C. Location: At Project site as designated by the Architect.
- D. Attendance:
 - 1. Contractor or Contractor's Representatives
 - 2. Job Superintendent
 - 3. Project Coordinator (Manager)

4. Owner or Owner's Representative
 5. Major subcontractors
 6. Major suppliers
 7. Architect's Representative
 8. Others as appropriate
- E. Meeting Agenda, may include, but is not limited to:
1. Discussion on major subcontracts and suppliers and projected construction schedules.
 2. Critical work sequencing.
 3. Major equipment deliveries and priorities. Discussion of long lead time items.
 4. Project coordination and designation of responsible personnel.
 5. Procedures and processing of field decisions, proposal requests, submittals, minor changes, change orders and applications for payment.
 6. Method of distribution of Contract Documents.
 7. Procedures for maintaining Record Documents.
 8. Use of premises, office work and storage areas, on-site parking, and Owner's requirements.
 9. Construction facilities and temporary utilities.
 10. Housekeeping procedures.

3.2 PROGRESS MEETINGS

- A. Architect will:
1. Schedule project meetings throughout progress of the work at weekly intervals, and specially called meetings.
 2. Set agenda and administer said meetings.
 3. Preside at meetings.
 4. Record meeting minutes, including all significant proceedings and decisions.
 5. Reproduce and distribute copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.
- B. Architect shall:
1. Make physical arrangements for meetings.
- C. Attendance:
1. Contractor or Contractor's Representative
 2. Job Superintendent
 3. Project Coordinator (Manager)
 4. Owner or Owner's Representative
 5. Major subcontractors
 6. Major suppliers
 7. Architect's Field Representative
 8. Consultants as needed
 9. Others as appropriate
- D. Meeting Agenda, may include, but is not limited to:
1. Review and approval of minutes of previous meeting.
 2. Review of Work progress since previous meeting.
 3. Field observations, problems, and conflicts.
 4. Review of off-site fabrication and delivery schedules.
 5. Corrective measures and procedures to regain projected schedule.
 6. Revisions to Construction Schedule.
 7. Plan progress and schedule during succeeding work period.
 8. Coordination of schedules.
 9. Review submittal schedules and expedite as required.

10. Maintenance of quality standards.
11. Allowance balances.
12. Review of proposed changes and substitutions for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other contracts of the Project.
13. Status of Allowance Expenditure Authorizations (AEAs).
14. Status of Change Proposal Requests (CPRs).
15. Status of Minor Changes (MCs).
16. Status of submittals, review of submittal log.
17. Other items and critical issues affecting Work.

3.3 PRE-INSTALLATION CONFERENCES

- A. In accordance with the requirements of Section 01 11 00, Notification of Architect Requirements, the Contractor will convene pre-installation conferences when required by individual specification Sections or as required by the Architect, prior to the Contractor commencing Work of the Section.
- B. Attendance, optional:
 1. General Contractor or Contractor's Representative
 2. Project Coordinator (Manager)
 3. Owner or Owner's Representative
 4. Architect's Project Manager (Project Executive)
- C. Attendance, required:
 1. Project Superintendent
 2. Architect's Field Representative
 3. Sub-contractor's Project Manager
 4. Sub-contractor's Foreman
 5. Engineer's Representative, as needed.
 6. Manufacturer's Representative, as needed.
 7. Governing Agency Official, as required
 8. Inspection Agency Representative, as required.
 9. Others affecting or affected by Work.
- D. Meeting Agenda, may include, but is not limited to:
 1. Review of conditions of installation.
 2. Preparation and installation procedures.
 3. Coordination with related work
 4. Review of the contract document requirements.
 5. Review of code enforcement or testing requirements.
 6. Questions related to work required.

3.4 PRE-CLOSEOUT MEETING

- A. In accordance with the requirements of Section 01 77 00, Closeout Procedures, the Contractor will convene a pre-closeout meeting when he considers the Work or designated portion of the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the work for its intended use.
- B. Attendance, required:
 1. Owner or Owner's Representative
 2. Project Coordinator (Manager)
 3. General Contractor or Contractor's Representative
 4. Project Superintendent
 5. Architect's Project Manager (Project Executive)
 6. Architect's Field Representative

7. Engineer's Representative, as needed.
- C. Meeting Agenda, may include, but is not limited to:
1. Review of the contract document requirements for Substantial Completion and Project Closeout
 2. Review of Work which remains to be completed or corrected.
 3. Closeout Document review schedule and log
 4. Review of closeout procedures including, but not limited to Record Drawings, Warrantees, Operation and Maintenance Manuals, and Owner Demonstrations and Start-up.
 5. Review of code enforcement or testing requirements.
 6. Questions related to work required.

END OF SECTION 01 31 19

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Schedules:
 - 1. Preliminary Analysis: Within 10 (ten) days after receipt of Award of Contract, submit a preliminary construction schedule for review by Owner and Architect.
 - 2. Construction Schedule: Within 14 (fourteen) days after receipt of Notice to Proceed, submit one (1) electronic file and four (4) prints of the approved construction schedule.
 - 3. Upon approval by the Architect and Owner, Contractor shall print out a color copy (large format) of the schedule and display on the wall of the contractor's office. A marking device shall be provided to track the overall schedule at a glance.

1.3 RELIANCE UPON SCHEDULE

- A. The construction schedule as approved by the Architect will be an integral part of the contract and will establish conditions for various activities and phases of constructions.

1.4 CONSTRUCTION SCHEDULE

- A. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished.
- B. Activities shown on the diagram shall include but not necessarily be limited to:
 - 1. Project mobilization
 - 2. Submittals and approvals of shop drawings and samples
 - 3. Phasing of construction
 - 4. Procurement of equipment and critical materials
 - 5. Fabrication and installation of special material and equipment
 - 6. Final clean-up
 - 7. Final inspection and testing
- C. The construction schedule shall be updated and submitted with each Application for Payment.

1.5 CONSTRUCTION SCHEDULE LIMITATIONS

- A. Work performed under this Contract shall be done in accordance with the following paragraphs:
 - 1. All work may proceed immediately upon Notice to Proceed and continue uninterrupted.
 - 2. The Owner has a critical need for the work to begin upon Notice to Proceed and to be Substantially Complete with the Work, in the various portions defined in Section 01 11 00 SUMMARY OF WORK, by their respective Substantial Completion dates established therein.
 - 3. Under the Base Proposal only, the successful Offeror will be 1) entitled to certain extensions of time and 2) subject to liquidated damages for work not completed beyond the agreed date which the Contractor shall require for Substantial

- Completion of the work included in this contract. Refer to Supplementary Conditions for additional requirements and liquidated damages.
4. Failure to complete and close-out project after substantial completion may result in liquidated damages. Refer to Supplementary Conditions for additional requirements and liquidated damages.
 5. The Owner may at his discretion approve changes recommended by the successful Offeror to the above-mentioned schedule provided that the Owner's use of newly completed areas are not disrupted.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION

3.1 PROJECT CONSTRUCTION SCHEDULE

- A. Meetings: Provide look-ahead schedule generated from construction schedule software for review at each Subcontractor Coordination and OAC Meeting.
- B. Project Construction Schedule Updating: At monthly intervals, on a regular monthly date specifically identified in the pre-construction conference, the Contractor shall update the schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting. Submit schedule with each application for payment.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including but not limited to, changes in logic, duration, actual starts and finishes, and activity duration.
 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their portion of the Work and are no longer involved in performance of construction activities.
- D. Recovery: If at any time during the course of the project, the critical path demonstrates the project is in excess of 15 calendar days behind schedule the Contractor shall provide within 5 days of notification, revisions to the schedule demonstrating the ability to return the project to the milestone and project delivery dates identified in the Contract Documents. In addition, the Contractor will revise all remaining work as necessary to reflect any changes in the planned execution.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect's action.
- B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- C. Portable Document Format (PDF): An open standard file format used for representing documents in a device independent and display resolution independent fixed layout document format.

1.4 SUBMITTALS

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

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

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

- c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - d. The following digital data files will be furnished for each appropriate discipline:
 - 1) Floor plans.
 - 2) Reflected ceiling plans.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 - 4. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.

- f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
- 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in PDF electronic file.
- C. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.
 3. Submit Shop Drawings in PDF electronic file.
 4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
 - a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
 - b. Refer to Section 01 31 00 for requirements for coordination drawings.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Within 60 days after date of Notice to Proceed, submit list of manufacturers proposed for use along with all samples and color selections. Submittal to contain all project required selections for the Architect and Owner to approve, including but not limited to the following: paint, laminates, carpet, porcelain tile, vinyl tile, etc. Partial color selection submittals will not be accepted.
3. Submit for aesthetic, color, or finish selection. Submit full range of manufacture's standard colors, textures, and patterns for Architect's selection.
4. Submit samples to illustrate functional characteristics of the Product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
5. Submit the number specified in respective Specification Section; minimum of two (2), of which one (1) will be retained by Architect.
6. Reviewed samples which may be used in the Work are indicated in individual specification sections.
7. Samples will not be used for testing purposes unless specifically stated in specification section
8. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
9. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
10. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
11. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Key Items Review Time: Submit samples to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items in Division 09 finishes within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.
 - b. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
 - 5. Submit product schedule in PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00.
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00.
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000.
- J. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00.
- K. Maintenance Data: Comply with requirements specified in Section 01 78 23.
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Guarantees
 - 1. When specified in individual specification sections, submit warranties by manufacturer, installation/application subcontractor, fabricator, or contractor to architect, in quantities specified.
 - 2. Submit warranties in accordance with section 01 77 00, closeout procedures.
- N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

- S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 - 1. In accordance with section 01 45 23, inspection and testing laboratory services, submit test reports for owner/architect/engineer's knowledge as contract administrators. Architect will determine whether corrective action is required.
- T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
 1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

2.3 MSDS SHEETS

- A. The Texas Asbestos Health Protection Rules (Title 25. Health Services, Part I. Texas Department of Health Chapter 295 - Occupational Health, Subchapter C - Texas Asbestos Health Protection) were approved and became effective on October 20, 1992, and amended March 27, 2003. The Rules established the procedures and means to implement the provisions of Senate Bill 1341 and House Bill 79.
- B. Pursuant to the above referenced Rules, submit MSDS Sheets showing that materials used in the Project, contain 1.0 percent or less asbestos. This requirement pertains to every material in every Section of the Specifications, as applicable to the Project, whether written therein, or not. Submit MSDS Sheets for materials, including, but not limited to the following, as applicable to the Project.
 1. Surfacing Materials:
 - a. acoustical plaster;
 - b. decorative plaster/stucco;
 - c. textured paint/coating;
 - d. spray applied insulation;
 - e. blown-in insulation
 - f. fire proofing insulation;
 - g. joint compound; and
 - h. spackling compounds
 2. Thermal System Insulation:
 - a. taping compounds (thermal)
 - b. HVAC duct insulation;
 - c. boiler insulation;
 - d. breaching insulation;
 - e. pipe insulation; and
 - f. thermal paper products
 3. Miscellaneous Material:
 - a. cement wallboard/siding;
 - b. asphalt/vinyl floor tile
 - c. vinyl sheet flooring/vinyl wall coverings;
 - d. floor backing;
 - e. construction mastic;
 - f. ceiling tiles/lay-in ceiling panels;
 - g. packing materials;
 - h. high temperature gaskets;
 - i. laboratory hoods/table tops
 - j. fire blankets/curtains;
 - k. elevator equipment panels;
 - l. elevator brake shoes;
 - m. ductwork flexible fabric connections;
 - n. cooling towers;
 - o. heating and electrical ducts;
 - p. electrical panel partitions;
 - q. electrical cloth/electrical wiring insulation;
 - r. chalkboards;

- s. roofing shingles/tiles;
- t. roofing felt;
- u. base flashing;
- v. fire doors;
- w. caulking/putties;
- x. adhesives/mastics; and
- y. wallboard

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 41 00 - REGULATORY REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance.
- B. References Standards.
- C. Definitions.
- D. Abbreviations.
- E. Format and Specification Context Explanations.
- F. Drawing Symbols.
- G. General Requirements.

1.2 QUALITY ASSURANCE

- A. General:
 - 1. For products or workmanship specified by a standard of an association, trade, or Federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code authorities having jurisdiction.
 - 2. The contractual relationship of the parties to the Contract should not be altered from the Contract Documents by mention or inference otherwise in any reference standard.
 - 3. Obtain copies of standards when required by Contract Documents.
 - 4. Maintain copy of standards at jobsite during submittals, planning, and progress of the specific work for which the standards pertain, until the date of Substantial Completion.
 - 5. In the absence of specific instructions in the specifications, materials, products, equipment and their installation shall conform to the applicable codes, regulations and standards specified therein. When a conflict exists between the applicable code, regulation and standard and that specified, the more stringent code regulation or standard shall prevail, except as authorized by applicable authorities having jurisdiction.
- B. Specifications and Drawings: The Drawings and Specifications are correlative and have equal authority and priority. Base disagreements in themselves or in each other on the most expensive combination of quantity and quality of work indicated. In the event of such disagreement bring it to the attention of the Architect, who will determine the appropriate method to perform the work.
- C. Industry Standards: Where compliance with two (2) or more industry standards or sets of requirements are specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer apparently equal-but-different requirements, and uncertainties as to which level of quality is more stringent, to the Architect for a decision before proceeding.

- D. Contractor's Option: Except for overlapping or conflicting requirements, where more than one (1) set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether or not it is specifically indicated as such.
- E. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended to be the minimum for the work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with the minimum (within specified tolerances), or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.
- F. Specialists' Assignments: In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists, who are engaged for performance of work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements should not be interpreted so as to conflict with applicable regulations, union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of requirements remains with the Contractor.

1.3 REFERENCE STANDARDS

- A. Dates of codes, regulations and standards specified shall be the latest date of issue of that code, regulation or standard prior to the date of issue of this Project Manual or Document, except as modified or otherwise directed by the applicable codes and their supplements and amendments adopted by the code authorities having jurisdiction.
 - 1. Date of Issue - The "date of issue" as it appears in the statement above, means the date which appears on the cover of the Project Manual or Document corresponding to the date of issue of the Contract Documents.
 - 2. Code Authorities: The "code authorities" as it appears in the statement above, means the authorities responsible for code enforcement.

1.4 DEFINITIONS

- A. General Explanation: A substantial amount of specification language consists of definitions for terms found in other Contract Documents, including those in the AIA A201 General Conditions of the Contract for Construction, Supplementary Conditions, the Drawings, and the Specifications. Drawings must be recognized as being diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the Contract Documents are defined in the General Conditions, Supplementary Conditions, and in this Section. Definitions and explanations contained in this Section are not necessarily either complete or exclusive, but are general for this Work to the extent that they are not stated more explicitly in another element of the Contract Documents. In the event of a conflict in definitions or explanations within the Contract Documents or whenever there is need of clarification or interpretation of definitions within or between the Contract Documents, notify the Architect immediately and proceed as directed. Except in cases where definitions are determined by code authorities having jurisdiction, the Architect's interpretation of all definitions will take precedence.
- B. General Requirements: The provisions or requirements of Division 1 - Sections apply to entire Work of Contract and, where indicated, to other elements which are included in the Project.

- C. Special Conditions: Wherever the term "Special Conditions", appears in the Contract Documents, it refers collectively to all requirements of the Owner in addition to the sections in Division 1, General Requirements, and to Articles contained in the General Conditions and Supplementary Conditions.
- D. Architect: Wherever the term "Architect" or any derivative thereof appears in the Contract Documents, it means PBK, 11 Greenway Plaza, 22nd Floor, Houston, Texas 77046, (713) 965-0608, or their authorized representative(s).
- E. Bid, Competitive Sealed Proposal (CSP), Response, Offer, etc.: Wherever the term "Bid", "Competitive Sealed Proposal (CSP)", "Response", "Offer", "Proposal", or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean Competitive Sealed Proposal, which by definition allows the Owner to accept the "best value" for the school district based on factors other than cost in selecting the Contractor.
- F. Contractor, General Contractor, Construction Manager, etc: Wherever the term "Contractor", "General Contractor", "Construction Manager" or any derivative thereof, or similar term appear in the Contract Documents, they mean one and the same.
- G. Subcontractor, Sub-subcontractor, Bidder, etc.: Wherever the term "Subcontractor", "Sub-subcontractor", "Bidder", "Bidder/Vendor", "Vendor", "Installer", "Integrator", "Respondent", "Offeror", or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall refer to the entity (person or firm) licensed and meeting all applicable regulations of the State of Texas and Department of Labor to perform the Work, or their authorized representative(s).
 - 1. Responsibilities: To avoid any misunderstanding or lack of interpretation, the responsibility for performing the Work is totally that of the entity defined above, and the resolutions proposed in his shop drawings and related documentation shall be demonstrated throughout the Work and specified warranty period.
 - 2. In the event of a controversy involving the Contract Documents or interpretation of Project requirements, the decision of the Architect will take precedence.
- H. District, School District, Owner, etc.: Wherever the term "District", "School District", "Owner", "Katy ISD", KISD, or similar such term appears in the Contract Documents, it means the Katy Independent School District, 6301 South Stadium Lane, Katy, Texas 77492, (281) 396-6150, or its authorized representative(s).
- I. Consultants: Wherever the term "Consultant", or any derivative thereof appears in the Contract Documents, it means the following to whom that portion of the work applies.
 - 1. Owner's Consultants:
 - a. Geotechnical Consultant: Terracon Consultants, Inc, Houston, Texas 77091 (713) 692-8373, or their authorized representative(s).
 - b. Surveyors: BGE, Inc., Houston, Texas (281) 558-8700, or their authorized representative(s).
 - 2. Architect's Consultants:
 - a. Civil Engineer: DIG Engineers, Houston, Texas 77046 (713) 965-0608, or their authorized representative(s).
 - b. MEP Engineer: LEAF Engineers, Houston, Texas 77046 (713) 965-0608, or their authorized representative(s).
 - c. Structural Engineers: ASA Dally, Houston, Texas 77042 (713) 337-8881, or their authorized representative(s).
 - d. Food Service Consultant: FDP, The Woodlands, TX 77380 (281) 350-2323, or their authorized representative(s).

- e. Landscaping Consultant: Green Scape Associates, Rosenberg, Texas 77471 (281) 341-9975, or their authorized representative(s).
 - f. Technology Consultant: PBK Engineers, *Technology Group*, Houston, Texas 77046 (713) 965-0608, or their authorized representative(s).
 - g. Roof Consultant: PBK Facilities *Group*, Houston, Texas 77046 (713) 965-0608, or their authorized representative(s).
 - h. Pool Consultant: Counsilman-Hunsaker, St. Louis, Missouri (314) 775-2241, or their authorized representative(s).
 - i. Acoustical Consultant: BAI, Austin, Texas (512) 476-3464, or their authorized representative(s).
 - j. Theatrical Consultant: Schuler Shook, Dallas, Texas (214) 747-8300, or their authorized representative(s).
- J. Indicated: Wherever the term "indicated", or any derivative thereof appears in the Contract Documents, it means a cross-reference to graphic representations, notes, or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- K. Directed, Requested, Etc: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" or any derivative thereof appears in the Contract Documents, it means as "directed by the Architect", "requested by the Architect", and similar phrases with actions taken by the Architect. However, no meaning or otherwise shall be interpreted to extend the Architect's responsibility into Contractor's area of construction supervision.
- L. Approve: Wherever the term "Approve", or any derivative thereof appears in the Contract Documents, it means only the Architect, or an individual designated by him as his representative, can approve or disapprove contract actions. Even if the specifications indicate that an individual other than the Architect, such as the "Engineer" or "Consultant" will approve or disapprove an action, it is understood that only the Architect has this authority unless the individual is so designated by him in writing. Even when an individual is so designated, the Contractor may appeal the action to the Architect and the Architect's decision will be final. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibility to fulfill requirements of the Contract Documents.
- M. Furnish: Wherever the term "Furnish", or any derivative thereof appears in the Contract Documents, it means supply or deliver to Project site, ready for unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- N. Install: Wherever the term "Install", or any derivative thereof appears in the Contract Documents, it means performing the operations at the Project site, of unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- O. Provide: Wherever the term "Provide", or any derivative thereof appears in the Contract Documents, it means furnish and install at the Project site, complete and ready for intended use, as applicable in each instance.
- P. Project, Site: Wherever the term "Project", "Site", or similar such term appears in the Contract Documents, it means the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing work as part of the

Project. The extent of project or site is shown on the Drawings, and may or may not be identical with description of land upon which Project is to be built.

- Q. Installer: Wherever the term “Installer”, or any derivative thereof appears in the Contract Documents, it means the 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, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.
- R. Specialist: Wherever the term “Specialist”, or any derivative thereof appears in the Contract Documents, it means an individual or firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in either (as applicable) manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing work required by the Contract. Where the Contract Specification requires installation by a specialist, that term shall also be deemed to mean either the manufacturer of the item or firm who will perform the work under the manufacturer’s direct supervision.
- S. Testing Laboratory: Wherever the term “Testing Laboratory”, or any derivative thereof appears in the Contract Documents, it means an independent entity engaged to perform specific inspections or tests of the work, either at the Project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

1.5 FORMAT AND SPECIFICATION CONTEXT EXPLANATIONS

- A. Underscoring: Is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where underscoring is used.
- B. Capitalization: Except for manufacturer, product, or trademark names, capitalization is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where capitalization is used.
- C. Imperative language: Is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by the Contractor, or when so noted, by others.
- D. Section Numbering: Is used to facilitate cross-reference in Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in Contract Documents.
- E. Page Numbering: Pages are numbered independently for each section. The section number is shown preceded by the project number and followed by the page number at the bottom of each page, to facilitate the location of text. The project number is given to identify the project, for which specification was written, should the section become separated from the Project Manual.
- F. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include “prescriptive, “open-generic descriptive”, “compliance with standards”, “performance”, or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.

- G. Abbreviations: The language of Specifications and other Contract Documents is of the abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in texts. Specific abbreviations 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. Trade association names and titles of general 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 the Contract Documents so indicates. A list of typical abbreviations, includes, but is not limited to the following trade associations and organizations. Refer to Drawings and other Contract Documents for other abbreviations.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Assn.
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
AGA	American Gas Association
AGC	Associated General Contractors of America
AHA	American Hardboard Association
AHGA	American Hotdip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron & Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	Air Conditioning & Refrigeration Institute
ASA	Acoustical Society of America
ASA	American Subcontractors Association
ASAH	American Society of Architectural Hardware Consultants
ASC	Adhesive & Sealant Council, Inc.
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Professional Engineers
ASPI	American Wood Preserver's Institute
ASTM	ASTM International
AWI	Architectural Woodwork Institute
AWS	American Welding Society
BIA	Brick Institute of America
BRI	Building Research Institute
CRA	California Redwood Association
CLFMI	Chain Link Fence Manufacturers Institute
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DHI	Door and Hardware Institute
EPA	Environmental Protection Agency
FTI	Facing Tile Institute
FGMA	Flat Glass Marketing Association
GA	Gypsum Association
HPMA	Hardwood Plywood Manufacturers Association
IBC	International Building Code
ICBO	International Conference of Building Officials

ICC	International Code Council
IEEE	Institute of Electrical and Electronic Engineers
JSMA	Joint Sealer Manufacturers Association
MFMA	Maple Flooring Manufacturers Association
ML/SFA	Metal Lath/Steel Framing Association
NAAMM	National Association of Architectural Metal Manufacturers
NAMM	National Association of Mirror Manufacturers
NBLP	National Bureau of Lathing & Plastering
NCPI	National Clay Pipe Institute
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Assn.
NESC	National Environmental Systems Contractors
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHLA	National Hardwood Lumber Association
NOMMA	National Ornamental Metal Manufacturers Assn
NPVLA	National Paint, Varnish and Lacquer Assn.
NRMCA	National Ready Mixed Concrete Assn.
NRCA	National Roofing Contractors Association
NSPE	National Society of Professional Engineers
NWMA	National Woodwork Manufacturers Assn., Inc.
OSHA	Occupational Safety and Health Administration
PDCA	Painting and Decorating Contractors of America
PI	Perlite Institute, Inc.
PCA	Portland Cement Association
RFCI	Resilient Floor Covering Institute
RVFC	Rubber and Vinyl Floor Council
SBCCI	Southern Building Code Congress International, Inc.
SFPA	Southern Forest Products Association
SHLMA	Southern Hardwood Lumber Manufacturing Assn.
SDI	Steel Deck Institute
SDI	Steel Door Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
TCA	Tile Council of America, Inc.
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
VBI	Venetian Blind Institute
VFI	Vinyl Fabrics Institute
WCLIB	West Coast Lumber Inspection Bureau
WRCLA	Western Red Cedar Lumber Association
WWPA	Western Wood Products Association

1.6 DRAWING SYMBOLS

- A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols defined by "Architectural Graphic Standards", published by the American Institute of Architects (AIA) and John Wiley & Sons, Inc., latest edition. Refer instances of uncertainty to Architect for clarification before proceeding.
- B. Mechanical/Electrical Drawings: Graphic symbols used in Mechanical/Electrical Drawings are generally aligned with symbols recommended by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). Where appropriate, those symbols are supplemented by more specific symbols as recommended by other recognized technical organizations, including, but not limited to American Society of

Mechanical Engineers (ASME), American Society of Professional Engineers (ASPE), Institute of Electrical and Electronic Engineers (IEEE) and similar organizations. Refer instances of uncertainty to Architect for clarification before proceeding.

1.7 GENERAL REQUIREMENTS

- A. Color, Texture, or Pattern Requirements:
1. When color, texture, or pattern is specified, the item, product, or material shall be furnished in the specified color, texture, or pattern, as applicable.
 2. When more than one (1) approved manufacturer is named in the Specifications, Contractor may select any of the approved manufacturers and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection.
 3. When the term "match existing", or any derivative thereof appears in the Contract Documents, it means that the sample must match the Owner's existing work in every respect as to color, texture, and pattern, as applicable.
 4. When the term "match Architect's approved sample", or any derivative thereof appears in the Contract Documents, it means that the Architect has selected a sample which must be matched in every respect as to color, texture, and pattern, as applicable.
 5. When an item or product is specified of a manufacturer for which only one (1) color, texture, or pattern is available, and a color, texture, or pattern other than that one is specified, Contractor shall bring it to the attention of the Architect for a decision prior to proceeding with the work. Do not proceed with the work until Architect has approved the color, texture, and pattern, as applicable.
 6. When an item or product is specified of a manufacturer for which no color, texture, or pattern is specified, and colors, textures, and patterns are available, Contractor shall bring it to the attention of the Architect and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection. Do not proceed with the work until Architect has selected and approved the color, texture, and pattern, as applicable.
 7. When due to the nature of the item, product, or material, i.e. face brick, tile pavers, natural stone, etc, Contractor shall submit sample or samples which exhibits the full range of characteristics (colors, i.e. lights and darks, as well as textures, and patterns) for which the item, product, or material is available. The Architect will select the color, texture, and pattern, as applicable, from those available and request a sample panel exhibiting the approved characteristics. The approved color range, texture, and pattern, as applicable will then become the standard for which all work on the project will be judged. Architect will be final judge as to having performed work in conformance with approved characteristics.
 8. Under no circumstances are colors, textures, patterns, or any other characteristics for which an item, product, or material are available to be selected by anyone other than the Architect or his authorized representative.
 9. Non-conforming work shall be removed from the site and replaced with new conforming work at no additional expense to Owner.
- B. Continuity of Building Envelope, Full Height Partitions, and Fire Rated Construction:
1. Continuity of Building Envelope:
 - a. All materials such as exterior sheathing, membrane flashings, vapor barriers, insulations, dampproofing, waterproofing, roofing, flashings, etc. and all penetrations, holes, gaps, joints, and openings through such materials shall be sealed to ensure continuity of building envelope, whether indicated or not.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with work.

REGULATORY REQUIREMENTS

2. Full Height Partitions:
 - a. All full height partitions shall be from floor to bottom of deck structure and shall be made to fit around steel joists, beams, etc., whether indicated or not.
 - b. Seal joints at top of partitions, in flutes of steel deck, and around structural elements with a compressible filler and/or sealant to accommodate movement due to expansion, contraction, and deflection, whether indicated or not. Treat seals in joints of fire rated partitions as specified below for fire rated construction, whether indicated or not.
 - c. Refer instances of uncertainty to Architect for clarification before proceeding with work.
3. Fire Rated Construction:
 - a. All seals in fire rated construction, whether at top, bottom, or penetrations through fire rated construction, shall be made with firestopping and fire safing materials to maintain fire rating integrity of construction and satisfy authorities having jurisdiction, whether indicated or not.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with work.
- C. Plumbing Line Protection:
 1. Placing or washing materials, including, but not limited to the following, down any plumbing line or fixture is strictly forbidden.
 - a. Concrete, cement, sludge, mortar, grout, plaster, or any other cementitious material
 - b. Paint, paint thinner, turpentine, kerosene, gasoline, oil, or any other petroleum or hazardous products.
 2. Cleaning painting equipment, including brushes in new or existing plumbing fixtures is strictly prohibited.
 3. If requested, Contractor shall certify that all affected plumbing lines and fixtures are clean, free flowing and running. Plumbing lines and fixtures damaged as a result of any of the above shall be repaired or replaced at no expense to Owner. Contractor shall bear responsibility and all costs of fines, penalties, and legal fees attributed to violations as levied by authorities having jurisdiction.
- D. Items Suspended From Structure:
 1. Suspend ductwork, piping, conduit, equipment and other items from framing using methods and devices acceptable to the Structural Engineer of Record ("Engineer").
 2. Where suspended loads exceed member design load capacity, provide field-added struts or other structural reinforcement acceptable to the Engineer.
 3. Do not attach items to, suspend items from, or drill into the structural deck.
 4. Use of the following is strictly prohibited unless specifically approved in writing for a particular application by the Engineer:
 - a. Sammy's® screws and similar screw-in threaded rod anchorage devices
 - b. Powder-actuated fasteners
 5. Attachment to and suspension from open web steel joists:
 - a. Do not use beam clamps.
 - b. Do not drill, screw or drive anything into joist chord or web members.
 - c. For nominal concentrated loads between panel points, which have been accounted for in the specified uniform design loads, a strut to transfer the load to a panel point on the opposite chord shall not be required, provided the sum of the concentrated loads within a chord panel does not exceed 100 pounds and the attachments are concentric to the chord (for example, vertical rods between, and bearing equally upon, both members of the chord).

- D. Ducts, Pipes, Conduits, and Wires: Shall be concealed in walls, chases, and enclosed areas out of view, unless specifically indicated as exposed or where exposure is required for proper function of item, such as air registers, air returns, louvers, grilles, vents, thermostats, electrical receptacles, telephone/data terminals and jacks, light switches, etc. Refer instances of uncertainty to Architect for clarification before proceeding.
- E. Fasteners:
1. Unless specifically indicated or directed otherwise, all fasteners in work exposed to view, shall be concealed in the finished work.
 2. No fasteners shall show through or telegraph through exposed face of finished work and all finished surfaces shall be free of all evidence of the existence of fasteners.
 3. Fasteners shall be spaced to accurately and rigidly secure work in place.
 4. If not shown or otherwise required or recommended by manufacturer, standard, or code authorities having jurisdiction, fastener spacing shall not exceed 12 inches on center.
 5. Non-conforming work shall be removed from the site and replaced with new conforming work at no additional expense to Owner.
- F. Exposed Metal Work:
1. Unless specifically indicated or directed otherwise, all exposed metal work shall be flat with all surfaces free of distortions, oil canning, waves, dents, scratches, weld marks, and other surface defects detrimental to good appearance or function.
 2. All steel exposed to exterior weather or moisture, either exposed or concealed in work, shall be hot-dip galvanized, phosphate treated for paint retention and shop prime painted.
 3. Non-conforming work shall be removed from the site and replaced with new conforming work at no additional expense to Owner.
- G. Continuous Date and Time Code Operated Devices:
1. Devices used in the construction of this Project which use continuous date and time codes in their operation, whether software or hardware, and whether upgradable or not, including, but not limited to air handling, lighting, alarm, communication, security, and instrumentation systems, elevators, escalators and other conveying systems. In addition, such devices shall remain compliant for 100 years or the life of the device, whichever comes first.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION *(Not Used)*

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance: Requirements for material and product quality and control of installation.
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' field services

1.2 RELATED SECTIONS

- A. Section 01 41 00 – Regulatory Requirements
- B. Section 01 45 23 – Testing and Inspecting Services
- C. Section 01 33 00 - Submittal Procedures
- D. Section 02 32 00 - Geotechnical Report
- E. The Work of this Section shall be included as a part of all Sections of Work, whether referenced therein or not.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Unless specifically noted otherwise, perform all Work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
 - 1. perform Work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section;
 - 2. perform Work in the highest quality workmanship, unless specified otherwise;
 - 3. join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work;
 - 4. install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials;

5. attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed;
6. use concealed fasteners, unless shown or directed otherwise.

1.4 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.6 REFERENCES AND STANDARDS

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

- F. Refer to Section 01 41 00, Codes, Regulations and Standards, for additional information concerning applicable reference and standards requirements.

1.7 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be the comparison standard for remaining Work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.
- E. Mock-up may be approved in phases as portions are completed.
- F. Project Mock-up Requirements: Provide an actual sample panel with the following properties:
 - 1. Size: Minimum 10 feet wide by 8 feet tall. Size may vary according to specific project requirements. Brace and support as required to withstand structural windloads.
 - 2. Materials: actual exterior finishes including, but not limited to face brick, cast stone, and plaster, actual building materials and assemblies indicating brick patterns on masonry and stud back-up as occurs with dampproofing and flashing as detailed, actual portion of aluminum storefront indicating jam, sill and head attachment, sunshade attachment, and flashing details, and where appropriate, provide mock-up of special finish details, insets and reliefs, reveals, expansion and control joints, brick ledges, brick head and sills, pipe penetrations and waterproofing materials. Provide roof edge flashing and gutter section (as applicable) in pre-finished color as selected by Architect to cap the mock-up panel. Include a sealant joint at least 24 inches long.
 - 3. Brace and support as required to withstand structural windloads.
 - 4. One (1) complete separate panel is required per construction type.
 - 5. Drawing: Actual mock-up drawing will be submitted by the Architect after submittals have been approved.

1.8 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform Work to contract requirements.
- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 45 23, Inspection and Testing Laboratory Services, for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

1.9 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.
- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- F. Inspecting does not relieve Contractor to perform Work to contract requirements.
- G. Refer to Section 01 45 23, Inspection and Testing Laboratory Services, for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

1.10 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.

- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00, Submittal Procedures, for additional information concerning submittal procedures and requirements for Manufacturers Field Reports.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 45 23 – STRUCTURAL TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, ASTM specifications and the Contract Documents.
- B. The testing laboratory shall provide as a part of the project's close-out documents or as required by any regulatory authority, all appropriate signed and sealed Special Inspection Certificates whose purpose would be to provide consistency and direction for compliance with the referenced Building Code. These Special Inspection Certificates shall confirm that that all work requiring special inspection has been adequately performed, and the special inspections have been made by an individual or firm that is qualified to make special inspections per the referenced Building Code.
- C. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.
- D. Testing, inspection, and certifications specified in other sections of these Specifications shall be paid by the Owner, unless otherwise indicated.
- E. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

1.3 REFERENCED STANDARDS

- A. The latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise.
- B. ACI 311 – ACI Manual of Concrete Inspection
- C. ACI 301 - Specification for Structural Concrete
- D. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY ASSURANCE

- A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.
- B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than \$500,000.

- C. Testing Laboratory shall be under the direction of a Registered Engineer who is legally authorized to practice in the jurisdiction where Project is located and having at least five years experience in inspection and testing of construction materials.
- D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.
- E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- F. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES

- A. Attend preconstruction meetings and progress meetings as required to coordinate work with the Contractor and address quality control issues.
- B. Test samples of design mixes submitted by Contractor.
- C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
- D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.
- E. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non conformance of Work or Materials.
- G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.
- H. Testing Laboratory shall write a letter at the completion of the project, signed, and sealed by a registered engineer in the state of the project, summarizing the inspections performed, the dates they were performed, and whether the observed construction complied with the Contract Documents.

1.6 LABORATORY REPORTS

- A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.
- B. Include:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and specifications section
6. Location in the Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

- A. See technical sections of these specifications for specific requirements.
- B. Deliver to the laboratory, without cost to the Owner, adequate samples of materials proposed for use which are required to be tested.
- C. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Provide facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM specifications C31.
- E. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.
- F. Furnish concrete mix designs, in accordance with ACI 301, section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs are required, the laboratory shall be selected and paid by the Contractor.
- G. Provide current welder certifications for each welder to be employed.
- H. Furnish fabrication and erection inspection of all welds in accordance with AWS D1.1, Chapter 6.
- I. Prequalification of all welding procedures to be used in executing the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PIER DRILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.
- C. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not casing is required, bell size (if required), actual penetration into bearing stratum, and elevation of top of bearing stratum.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.
- B. Observe and report on the following:
 - 1. Number and size of bars
 - 2. Bending and lengths of bars
 - 3. Splicing
 - 4. Clearance to forms including chair heights
 - 5. Clearance between bars or spacing
 - 6. Rust, form oil, and other contamination
 - 7. Grade of Steel
 - 8. Securing, tying and chairing of bars
 - 9. Excessive congestion of reinforcing steel
 - 10. Installation of anchor bolts and placement of concrete around anchor bolts
 - 11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents

- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.3 REINFORCING STEEL MECHANICAL SPLICES

- A. Each mechanical splice shall be visually inspected to ensure compliance with the ICBO Reports and the manufacturer's published criteria for acceptable completed splices.
- B. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the ICBO report.

- C. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and whether splice is accepted or rejected. Reasons for rejection shall be shown on each report.

3.4 CONCRETE INSPECTION AND TESTING

- A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.
- B. Mold and cure specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.
- C. Test specimens in accordance with ASTM C39. Two specimens shall be tested 7 days, two specimens shall be tested at 28 days for strength acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28-day break does not meet strength requirements. If the plans require 56-day break (such as for mass concrete), two samples shall be tested at 56 days for acceptance.
- D. Make one strength test (four or five cylinders) for each:
 - 1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
 - 2. OR, for each 5000 sq. ft. of slab area placed in one day.
 - 3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Architect/Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.
- E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.
- F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- G. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- H. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.
- I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Architect, the Contractor, and the Concrete Supplier.
- J. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications and shall be rejected.

- K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.
- L. Laboratory reports shall contain the following information:
 - 1. Class of concrete and specific location.
 - 2. Specified strength of concrete.
 - 3. Air temperature.
 - 4. Batch time.
 - 5. Specified time that discharge of concrete must be completed, based on air temperature.
 - 6. Time concrete is placed.
 - 7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
 - 8. Amount of water added at the site.
 - 9. Allowable slump range on the approved mix design.
 - 10. Slump.
 - 11. Maximum and minimum allowable concrete temperature on the approved mix design.
 - 12. Temperature of the concrete mix.
 - 13. Air content range on the approved mix design.
 - 14. Air content.
 - 15. Statement that concrete is in compliance with the project documents and the approved mix designs.
- M. Evaluation and Acceptance:
 - 1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
 - 2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.
- N. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- O. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).
- P. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

3.5 MASONRY

- A. Inspection

1. Provide a qualified inspector to inspect all structural masonry work.
 - a. Inspect masonry for compliance in accordance with the "Level 1 or 2 Special Inspection" provisions of the building code. Refer to the contract documents regarding which level of special inspections is required.
2. In combination with inspections required by the building code, inspect the following:
 - a. Preparation of masonry prisms for testing.
 - b. Placement of reinforcing.
 - c. Cavities to be grouted (prior to grouting and prior to closing cleanouts).
 - d. Mortar mixing operations, including proportion of materials and method of measuring materials (materials should be measured with a mixing box and not a shovel).
 - e. Bedding of mortar for each type of unit and placing of units.
 - f. Grouting operations.
 - g. Condition of units before laying for excessive absorption.
3. Provide report of each inspection.

B. Field Compressive Tests for Grout:

1. Secure composite samples of grout at the jobsite in accordance with ASTM C 1019.
2. Mold and cure three specimens from each sample in accordance with ASTM C 1019. Supervise the curing protection provided (by others) for test specimens in the field and the transportation from the field to the laboratory. The test specimens shall be stored in the field 24 to 48 hours and then be carefully transported to the laboratory and cured in accordance with ASTM C 1019.
3. Test specimens in accordance with ASTM C 1019. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at 7 days for information.
4. Make one strength test (three specimens) for each 10 cubic yards of grout poured but not less than one strength test for each 5000 square feet of wall area.

C. Prism Tests:

1. Build prisms at the jobsite using the same materials and methods as being used for the wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as masonry construction. After 48 hours, move prisms to the laboratory and test in accordance with ASTM C1314.
2. Make prism tests in advance of operations using materials under same conditions, with the same bonding and construction methods as is being used for the structure. When building prisms, moisture content of the units at time of laying, consistency of mortar and width and thickness of mortar joints shall be same as used in the structure.
3. Build prisms of hollow masonry units the same width as unit by 16" long by 16" high. Apply mortar to face shells only. Do not fill hollow core with grout. Compute value of ultimate net compressive strength, by dividing ultimate load by net face shell area of masonry units.
4. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to the jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5000 square feet of wall placed.
5. The prisms shall be tested after 28 days but may be tested at seven days provided the relationship between seven and 28 day strengths has been established for the materials used prior to the start of construction.

6. When the average strength of a set of prisms falls below the specified compressive strength (f'_m), the masonry corresponding to the test shall be deemed unacceptable. In such a case, notify the Architect and Contractor immediately.

3.6 STRUCTURAL STEEL

- A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.
- B. Field Inspection
 1. Proper erection of all pieces.
 2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
 3. Plumbness of structure and proper bracing.
 4. Field Painting.
 5. Visual examination of all field welding.
 6. Ultrasonic testing of all penetration welds.
 7. Installation of field welded shear studs.
 8. Measure and record camber of all beams upon arrival and before erection for compliance with the specified camber. Measure lying flat with web in horizontal position. Members outside specified camber tolerance shall be returned to the shop for remedial work.
- C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify all welder's qualifications.
- D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:
 1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
 2. Ultrasonically test all penetration welds in accordance with AWS D1.1.
 3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.
 4. The welding inspector shall be present during alignment and fit-up of members being welded and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
 5. The inspector shall check that all welds have been marked with the welder's symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
 6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other

- than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.
7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
- E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:
1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.
 2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration and shall confirm that the procedure to be used provides the required tension.
 4. For slip critical connections, inspect the contact surfaces for compliance with specifications prior to bolting.
- F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1 and as follows:
1. A minimum of two shear studs shall be welded at the start of each day's production period in order to determine proper generator, control unit and stud welding setting. These studs shall be capable of being bent at 45 degrees from vertical without weld failure.
 2. When the temperature is below 32 degrees Fahrenheit, one stud in each 100 shall be tested after cooling. Studs shall not be welded below zero degrees Fahrenheit or when the surface is wet due to rain, snow, or ice. If a stud fails, two new studs shall pass the test before resumption of the welding.
 3. Visually inspect studs for compliance with the Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

3.7 STEEL ROOF DECK

- A. Field inspection shall consist of the following:
1. Checking types, gauges, and finishes for conformance with the Contract Documents and Shop Drawings.
 2. Examination for proper erection of all metal deck, including fastenings at supports and sidelaps, reinforcing of holes, and miscellaneous deck supports.
 3. Certification of welders.
 4. Visual inspection of at least 20 percent of all welds.

3.8 SPRAYED FIREPROOFING

- A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify that installation meets fire rating requirements of approved design.

- C. Inspect and test for thickness as follows:
 - 1. Test 20 percent of structural frame columns and beams in each building level.
 - 2. Test 10 percent of beams other than structural frame in each building level.
 - 3. Test one slab per each 5000 square feet of building area.
- D. Inspect and test for density on slabs, beams, and columns. Perform one of each test for each 10,000 square feet of building area.
- E. Inspect and test for bond strength, one test for beams and one test for slabs for each 10,000 square feet or area.
- F. Inspection and test procedures shall be performed in accordance with ASTM E605 and E736.

3.9 EXPANSION BOLT INSTALLATION

- A. Inspect the drilling of each hole and installation of each expansion bolt for compliance with the Contract Documents.
- B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.10 TESTING OF NON-SHRINK GROUT

- A. Make one strength test for every 15 base plates grouted and for every 15 bags of grout used in joints between members.
- B. Each test shall consist of four cubes, two to be tested at seven days, and two at 28 days, made and tested in accordance with ASTM C109, with the exception that the grout shall be restrained from expansion by a top plate.

3.11 EXCAVATION

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.
- C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.
- D. Review required submittals as they pertain to geotechnical requirements.
- E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.

- F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

3.12 WATER PRESSURE INJECTION OR LIME SLURRY PRESSURE INJECTION

- A. The representative of the Owner's Geotechnical Engineer shall make continuous observations throughout the injection operations as per the geotechnical report.
- B. The representative of the Owner's Geotechnical Engineer may propose to perform additional tests if required to properly evaluate the injected soil. The representative of the Owner's Geotechnical Engineer shall evaluate the results of the tests to determine the acceptability of the injected areas and to determine if additional injections are required.

3.13 FILLING AND BACKFILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
- C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:
 - 1. Test for liquid limit in accordance with ASTM D423.
 - 2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
 - 3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.
- D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.
- E. Inspect under slab drainage material and placement for compliance with specified gradation, quality, and compaction.
- F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:
 - 1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
 - 2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
 - 3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

3.14 EXISTING FOUNDATION DEMOLITION

- A. While it is common for the testing and inspections laboratory to be involved and on-site during earthwork prep. and operations; (including but not limited to: observing and testing earthwork properties, select fill properties, thicknesses, compaction, moisture content, etc.) We also require the testing and inspections laboratory to be on-site for the infill of any and all demolished foundation items, both partially and fully demolished. We have observed instances where the demo contractor did not properly/adequately infill the sub-grade voids and/or compact the infill from existing demolished foundations. When the new building was constructed, the inadequate fill/compaction led to water intrusion problems and questionable bearing. We require that the testing and inspections laboratory be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved.
1. The owner shall be aware that this additional testing inspection scope will be required.
 2. The general contractor shall inform the demolition contractor(s) that the infill of the demolished foundations will be required to meet the earthwork requirements and be testing for compliance and any additional cost associated with ensuring the infill meets these parameters shall be included in their base bid.

END OF SECTION 01 45 23

SECTION 01 45 23 - TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements and qualifications including but not limited to:
 - 1. Professional testing and laboratory services.
 - 2. Accessories necessary for the completion of testing and laboratory services.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.
- C. General Contractor needs to provide their own qualified testing agency within the general requirements. The client's testing agency is only to verify the standards of the project are met.
 - 1. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.
- D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and the Contract Documents.
- E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at Contractor's expense.
- F. Where terms "Inspector" and "Laboratory" are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.
- G. Laboratory inspections shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.
- H. Contractor or Fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.
- I. Contractor to address deficiency and failed reports.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329 and ASTM E534; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
 - 3. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of \$500,000.00.
- B. Inspection and testing services the of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.
- C. Concrete Inspectors: Inspecting personnel monitoring concrete Work shall be ACI certified inspectors.
- D. Structural Steel: Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, *Standard and Guide for Qualification and Certification of Welding Inspectors*.
 - 1. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the Primary Inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.
- E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.
- F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY CONTROL

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Refer to the individual specification sections for specific requirements.
 - 2. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.

3. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 4. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 5. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
 8. Associated Responsibilities and Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - a. Provide access to the Work.
 - b. Deliver of samples to testing laboratory, without cost to Owner, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - c. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
 - d. Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31.
 - e. Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
 - f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - g. Provide concrete mix designs in accordance with ACI 301 Section 3.9 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
 - h. Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of the Contractor.
 - i. Provide current welder certificates for each welder employed.
 - j. Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1, Chapter 6.
 - 1) Use prequalification of welding procedures in executing the Work.
 - k. Security and protection for samples and for testing and inspecting equipment at Project site.
 9. Retesting/Reinspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and reinspecting, for construction that replaced Work failing to comply with the Contract Documents or Code requirements.
- C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- D. Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.5 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

- A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in preconstruction conferences. The representative shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.
- B. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques and report the progress to the Architect.
- C. If material or Work fails to meet requirements of Contract Documents, laboratory inspector shall notify the Construction Manager, Architect, Engineers, supplier or subcontractor providing or preparing the materials or Work being tested of such failure.
- D. Laboratory personnel shall not perform the Work of the Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.
- E. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.
- F. Comply with building code requirements for Special Inspections.

1.6 SUBMITTALS

- A. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality control service.

- C. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- D. Submit copies of reports of each inspection and test:
 - 1. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One copy each.
 - 2. Construction Manager and Contractor: Two copies each.
- E. In addition to furnishing a written report, notify Construction Manager and Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to the Architect and Engineer.
- F. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work and full compliance with requirements of Contract Documents.
- G. Submit copies of test results sealed by a Registered Engineer to municipal authorities having jurisdiction, as required.

1.7 TESTING LABORATORY GUIDELINES AND PROCEDURES

- A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the site.
- B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.
- C. There shall be a three hour minimum for each scheduled testing service. Vehicle charges will be included on a \$25.00 per trip basis.
- D. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is \$40.00 on week days and \$50.00 on weekends and holidays with no technician or vehicle charge.
- E. The Contractor shall bear the responsibility of scheduling the testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services.

Cancellations or failed test shall be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
 - 5. Deficiency log.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 TESTING AND INSPECTION SERVICES

- A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.
- B. The Owner reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.
- C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

3.3 TESTING OF EARTHWORK

- A. Testing Services (As specified or required):
 - 1. References (As applicable for tests required):
 - a. American Society for Testing and Materials (ASTM)
 - 1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³).
 - 2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
 - 3) D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - b. American Association of State Highway and Transportation Officials (AASHTO).
 - 1) T89, Determining the Liquid Limit of Soils.
 - 2) T90, Determining the Plastic Limit and Plasticity Index of Soils.
 - 3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12-in) Drop.
 - 4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth).
 - 2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab on grade, and backfills.

3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
 4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
 5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material,
 6. Perform one for each 4,000 square feet (445 square yards) of existing subgrade material.
 7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
 8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one test for each 4,000 square feet (445 square yards) of each lift of compacted fill.
 9. Perform testing at a frequency of one in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three tests per lift.
- B. Reports: Submit reports with the following information:
1. Type and condition of soil at footing bottoms.
 2. Level of water table in the excavated areas.
 3. Grain size distribution of fill materials (average of three tests).
 4. Moisture density test results.
 5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
 6. Notify Architect by telephone within one hour of the discovery of the following conditions and follow up telephone notification with written report.
 - a. Materials used, or degree of soil compaction not meeting specified requirements.
 - b. Frost and freeze protection requirements for excavation bottoms not being complied with.
 - c. Water in excavations which is not being removed prior to Work being performed in excavation.

3.4 INSPECTION OF PIPED SITE UTILITIES

- A. Laboratory representative shall observe and report on the following:
1. Proper alignment and grade of trenches.
 2. Pipe bedding and supports.
 3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
 4. Installation of pipe and joints.
 5. Testing of piped utilities performed by Contractor.

3.5 PAVING

- A. Testing Services: Perform field tests for moisture density properties:
1. Provide field testing of the subgrade as specified.
 2. Paving Subbase: Provide one field test for every 7,500 square feet of area of crushed limestone or caliche subbase.
 3. Lime Treated Subgrade: Provide one field test for every 7,500 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
 4. Cement Soil Stabilization: Provide one field test for every 7,500 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

3.6 PIER DRILLING OPERATION

- A. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.
- B. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.
- C. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
 - 1. Verify soundness of bearing stratum and desired penetration.
 - 2. Verify pier dimensions and reinforcing used.
 - 3. Monitor condition of hole and removal of water and loose material from bottom.
 - 4. Monitor placement of concrete and use of tremie or pumps.
 - 5. Monitor the extraction of casing, if used.
- D. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and, if left uncorrected, reported to the Architect.
- B. Laboratory representative shall observe and report on the following:
 - 1. Number and size of bars.
 - 2. Bending and lengths of bars.
 - 3. Splicing.
 - 4. Clearance to forms, including chair heights.
 - 5. Clearance to sides and bottom of trench if soil formed.
 - 6. Clearance between bars or spacing.
 - 7. Rust, form oil, and other contamination.
 - 8. Grade of steel.
 - 9. Securing, tying, and chairing of bars.
 - 10. Excessive congestion of reinforcing steel.
 - 11. Installation of anchor bolts and placement of concrete around such bolts.
 - 12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.8 CONCRETE INSPECTION AND TESTING

- A. Receive and evaluate proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect

certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and 318.

- B. Comply with ACI 311 *Guide For Concrete Inspection* and ACI *Manual of Concrete Inspection* (SP-2).
- C. Sample and test concrete placed at the site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.
- D. Test concrete:
 - 1. Mold and cure five specimens from each sample.
 - a. For each 50 cubic yards or fraction thereof of structural building concrete; and
 - b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
 - c. Laboratory cure two cylinders in accordance with ASTM C192.
 - d. Field cure remaining cylinders in accordance with ASTM C31.
 - 2. Two specimens shall be tested at seven days for information, two shall be tested at 28 days for acceptance.
- E. Deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.
- F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.
- G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.
- H. Make one strength test (four cylinders) of each mix design of concrete placed in any one day.
- I. Make one slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.
- J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.
- K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- L. Determine temperature of concrete sample for each strength test.
- M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94.
 - 1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.
- N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and

transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.

- O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to the Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.
- P. Observe placing of concrete, except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.
- R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.
- S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.
- T. Evaluation and Acceptance:
 - 1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
 - 2. Strength level of concrete will be considered satisfactory if the averages of sets of three consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
 - 3. Completed concrete Work will be accepted when requirements of ACI 301 Chapter 18 *Specifications for Structural Concrete for Buildings* have been met.
- U. Concrete Test Reports: Reports shall be made and distributed immediately after respective tests or inspections are made.
 - 1. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.
- V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
 - 1. Strength tests at 7 days of one cylinder.
 - 2. Strength tests at 28 days of two cylinder averages.
 - 3. 28 day moving average strength tests of last three test groups.
 - 4. Standard deviation and coefficient of variation based on 28 day strength tests.
 - 5. Average strength and number of 28 days tests for most recent month.

- W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.
- X. Noncompliant Test Reports: Fax test reports indicating noncompliance immediately to each party on the test report distribution list. Copies shall be on different colored paper.
- Y. Inspect application of curing compound and monitor curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect.

3.9 EXPANSION BOLT INSTALLATION

- A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.
- B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.10 REPAIR AND PROTECTION

- A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 29.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 45 20

SECTION 01 50 00 - TEMPORARY FACILITIES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Specific administrative and procedural minimum actions are specified in this Section, as extensions of provisions in other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this Section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication that such temporary activity is not required for successful completion of the Work and compliance with requirements of the Contract Documents. Provisions of this Section are applicable to, but are not limited to the temporary power, temporary water, temporary heat, field office, mobile telephone, sanitary facilities, storage facilities, signs, barriers, security, construction fence, cleaning, first aid facilities, fire protection, construction aids, parking facilities, storm water control and pollution prevention plan, as further expanded in this Section.

1.2 JOB CONDITIONS

- A. General: Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time, when no longer required or when permanent facilities have, with authorized use, replaced their need.
- B. Conditions of Use:
 - 1. Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary, and protective of persons and property, and free of deleterious effects.
 - 2. Be responsible for overloading or excess use of or damage resulting from the overloading or excess use of existing utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials, not specifically described herein, but required for proper completion of Work of this Section, may be new or used as selected by the Contractor, but shall be of design, type, size, and strength recommended to suit intended purpose.
- B. Items required to protect the tenants, workmen, and public from danger, shall be sufficiently designed to protect them. Where required, exclude the public from all hazards.

PART 3 - EXECUTION

3.1 UTILITIES

- A. Temporary Power: Provide temporary power and all wiring, lamps, distribution of power, and equipment required for construction, inspection and testing of Work. The Owner shall be responsible for and shall pay for all reasonable utility costs after permanent utility connections have been made.

- B. Temporary Water: Provide temporary water and all hoses and equipment required for construction, inspection and testing of Work. The Owner shall be responsible for and shall pay for all reasonable utility costs after permanent utility connections have been made.
- C. Temporary Climate Control: Provide temporary climate control (heating, cooling and humidity control) required for construction of Work.
 - 1. Provide heat to prevent freezing and to avoid damage to materials in storage, during and after installation, and during curing and drying of materials and finishes. Provide and maintain such dependable source of supply of heat, cooling, and humidity control as necessary until the Work is accepted. No open fire heaters will be permitted. No mold, mildew, rust, or sagging materials due to humidity will be allowed. Contractor shall remediate any and all evidence of mold, mildew, or rust per applicable state standards and requirements.

3.2 FIELD OFFICE

- A. Furnish a job trailer installed at a suitable location on site for use by the Contractor and the Architect.
- B. Provide adequate parking area adjacent to job trailer to match construction standards specified in 01 57 25.
- C. 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 Owner and Architect. Provide lights, electricity, air conditioning and heat, as required. Remove office from premises when one can be set up inside the building. Provide job telephone and other miscellaneous items as outlined below.
 - 1. Provide a separate locked room to serve as an office for the Owner and Architect, of an area of 100 SF, or provide in a separate building in close proximity to Contractor's office.
 - 2. Contractor's office shall be of a size, and furnished, so that it may be used for progress meetings.
 - 3. Provide adequate artificial lighting, heating and cooling to provide comfortable conditions for occupants.
 - 4. Provide direct line telephone service, for both voice communication and facsimile machines at Contractor's office and Owner/Architect's office.
 - 5. Provide high speed wireless internet access; DSL or broadband. Dial-up connection is not acceptable. Wireless connection password to be made available to all Owner and Architect representatives.
 - 6. Maintain a complete set of Construction Documents, Submittals, Record Documents, and other pertinent information for Contractor, Architect, Engineer, and Owner use.
 - 7. Furnishings Required:
 - a. For 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.
 - b. For Owner/Architect's office: Two four (4) drawer metal file cabinets, one lay-out drafting table 36 inch by 72 inch by 36 inch high; and drafting stool. Provide one drawing rack for 30 inch by 42 inch drawings. The Contractor will pay the monthly phone charges for all calls and base service charges for phone lines and fax lines that are brought into the Owner/Architect office. Provide the Owner and Architect with a key to the Owner/Architect office only.

3.3 MOBILE TELEPHONE

- A. Furnish and maintain a mobile telephone for his superintendent's use for the duration of the Project.

3.4 SANITARY FACILITIES

- A. Furnish and maintain temporary sanitary facilities. Comply with regulations of State Department of Health and other authorities having jurisdiction. The Contractor may not use the Owner's facilities.

3.5 STORAGE FACILITIES

- A. Provide and maintain adequate weathertight lockable storage facilities, raised above the ground, with sides and top enclosed.
- B. Replace materials improperly stored and damaged by weathered conditions.
- C. Remove storage facilities when materials can be stored within the structure in a secure and weathertight condition.
- D. Provide for temporary freeze protection as needed.

3.6 SIGNS

- A. Furnish and install a project sign 8'-0" by 8'-0" in size. Image will be provided to the graphics printing company by the Architect after Award of Contract. Contractor will be responsible for the cost of printing the image, mounting the sign on an aluminum substrate and installing the sign at the site. The sign will include the name of the project, District, name and title of Board of Trustees, District Superintendent, Contractor, Architect, and each of the project consultants.
- B. Other signs permitted at the site:
 - 1. Warning signs.
 - 2. Directional signs.
 - 3. Identification signs at field offices.
 - 4. Emergency medical services sign.
 - 5. Signs required by Authorities Having Jurisdiction
 - 6. Storm Water Pollution Prevention Plan sign (SWPPP)
- C. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the Owner.

3.7 BARRIERS

- A. Provide temporary barricades on all portions of the site adjacent to the construction and accessible to the public.
- B. Provide approved barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, water puddling and continuous running water.

3.8 SECURITY

- A. Determine if and when watchmen are necessary for protection of the Work, and provide such services when necessary. 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.

3.9 CONSTRUCTION FENCE

- A. Provide a minimum 6 feet-0 inch high chain link construction fence around the perimeter of the construction area for the duration of the construction period. Said temporary construction fence shall have lockable access gates necessary to adequately access the site in order to execute the project. Access gates shall be locked at the completion of each day's work. No gaps or openings will be allowed.

3.10 CLEANING

- A. Trash removal: Clear the building daily, and site of trash at least once a week. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper and cardboard daily. Dumpsters will not be allowed to overflow and should be emptied on a regular basis.
- B. Disposition of Debris: Remove debris from site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restriction. Neither debris nor material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.
- C. Final Cleaning: Thoroughly clean the Work, including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations, and other foreign materials.

3.11 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 field office telephone, listing the telephone numbers for emergency medical services: Physicians, ambulance services and hospitals.

3.12 TEMPORARY FIRE PROTECTION

- A. Provide a fire protection and prevention program for employees and personnel at the site; and provide and maintain fire extinguishing equipment ready for instant use at all areas of the Project and at specific areas of critical fire hazard.
- B. Equipment:
 - 1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
 - 2. Barrels of water with buckets designated for fire-control purposes.
 - 3. Water hoses connected to an adequate water pressure and supply system.
 - 4. Construction period use of permanent fire protection system.
- C. Enforce fire-safety discipline:
 - 1. Store volatile materials in an isolated, protected location.
 - 2. Avoid accumulations of flammable debris and waste in or about the Project.
 - 3. Prohibit smoking in the vicinity of hazardous conditions.
 - 4. Closely supervise and provide fire watches as required by authorities having jurisdiction during and after welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions.
 - 5. Supervise locations and operations of portable heating units and fuel.

- D. Contractor shall maintain fire-extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.

3.13 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the Work; Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.
- B. Maintain all equipment in a first-class, safe condition.

3.14 PARKING FACILITIES

- A. Coordinate location of parking for personnel and employees at the facility to avoid interference with traffic, walks, work and storage areas, or with materials-handling equipment.
- B. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

3.15 STORM WATER CONTROL & POLLUTION PREVENTION PLAN

- A. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas. Refer to Civil Drawings for additional requirements.
- B. Provide and maintain a Storm Water Pollution Prevention Plan in accordance with Federal EPA requirements. All inspections and reports / observations are to be forwarded to the Owner and Architect.
- C. File an EPA "Notice of Intent" Form with the EPA **before construction begins.**

END OF SECTION

SECTION 01 57 19 - GENERAL SOURCE CONTROLS

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes erosion and sedimentation control and other control related practices, which shall be utilized during construction activities.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.
- B. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated construction area. Damages caused by construction traffic or others to erosion and sedimentation control systems shall be repaired immediately by the Contractor.
- C. The Contractor shall be responsible for collecting, storing, hauling, and disposing of spoils, silt, and waste materials as specified on the Drawings and in this or other Technical Specifications and in compliance with applicable federal, state, and local rules and regulations.
- D. Contractor shall conduct all construction operation under this Contract in conformance with the erosion control practices described on the Drawings, the Storm Water Pollution Prevention Plan and this Section.
- E. The Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified on the Drawings and in this and other Technical Specifications.
- F. Contractor shall employ protective measures to avoid damage to existing trees to be retained on the project site.

3.2 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENTATION CONTROL SYSTEMS

- A. When topsoil is called for as a component of another Section, the Contractor shall conduct erosion control practices described in this Section during topsoil placement operation.
- B. When placing topsoil, maintain erosion and sedimentation control systems.
- C. Maintain grades, which have been previously established on areas to receive topsoil.
- D. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, the subgrade shall be loosened by discing or by scarifying to a depth of at least two (2) inches to permit bonding of the topsoil to the subsoil.

- E. No sod or seed shall be placed on soil, which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials.

3.3 DUST CONTROL

- A. Dust control methods shall be implemented to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving stream or storm water conveyance system, to reduce on and offsite damage, to prevent health hazards, and to improve traffic safety.
- B. Contractor shall control dust blowing by utilizing one or more of the following methods:
 - 1. Mulches bound with chemical binders.
 - 2. Temporary vegetative cover.
 - 3. Spray-on adhesives on mineral soils when not used by traffic.
 - 4. Tillage to roughen surface and bring clods to the surface.
 - 5. Irrigation by water sprinkling.
 - 6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.
- C. Dust control methods shall be implemented immediately whenever dust can be observed blowing on the project site.

3.4 KEEPING STREETS CLEAN

- A. Contractor shall keep the streets clean of construction debris, dirt, and mud generated by construction vehicles and equipment. If necessary to keep the streets clean, Contractor shall provide stabilized construction exits at construction, staging, storage, and disposal areas. A vehicle/equipment wash area (stabilized with coarse aggregate) may be installed adjacent to the location of stabilized construction exit, as needed. Wash water shall be released into a drainage swale or inlet protected by erosion and sediment control measures.
- B. In lieu of or in addition to stabilized construction exits, Contractor shall shovel and/or sweep the pavement to the extent necessary to keep the street clean. Water hosing or sweeping of debris and mud off of the street into adjacent areas is not allowed.

3.5 EQUIPMENT MAINTENANCE AND REPAIR

- A. Maintenance and repair of construction machinery and equipment shall be confined to areas specifically designated for that purpose. Such designated areas shall be located and designed so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed into receiving streams or storm water conveyance systems. These areas shall be provided with adequate waste disposal receptacles for liquid as well as solid waste. Maintenance areas shall be inspected and cleaned daily.
- B. On the construction site where designated equipment maintenance areas are not feasible, care shall be taken during each individual repair or maintenance operation to prevent potential pollutants from becoming available to be washed into streams or conveyance systems. Temporary waste disposal receptacles shall be provided.

3.6 WASTE COLLECTION AND DISPOSAL

- A. Contractor shall formulate and implement a plan for the collection and disposal of waste materials on the construction site. The plan must designate locations for trash and waste receptacles and establish a collection schedule. Methods for ultimate disposal of waste shall be specified and carried out in accordance with applicable local, state and federal health and

safety regulations. Special provisions shall be made for the collection and disposal of liquid wastes and toxic or hazardous materials.

- B. Receptacles and other waste collection areas shall be kept neat and orderly to the extent possible. Waste shall not be allowed to overflow its container or accumulate for excessively long periods of time. Trash collection points shall be located where they will least likely be affected by concentrated storm water runoff.

3.7 WASHING AREAS

- A. Vehicles such as concrete or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow into a watercourse or storm water conveyance system. Special areas shall be designated for washing vehicles. These areas should be located where the wash water will spread out and evaporate or infiltrate directly into the ground, or where the runoff can be collected in a temporary holding or seepage basin. Wash areas shall have gravel or rock bases to minimize mud generation. These areas shall be completely cleaned up, have waste remains hauled off, and be stabilized and seeded after the area is no longer required.

3.8 STORAGE OF CONSTRUCTION MATERIALS, CHEMICALS, ETC.

- A. Sites where chemicals, cements, solvents, paints, or other potential water pollutants are to be stored, shall be isolated in areas where they will not cause runoff pollution.
- B. Toxic chemicals and materials, such as pesticides, paints, and acids shall be stored in accordance with manufacturers' guidelines. Groundwater resources shall be protected from leaching by placing a plastic mat, packed clay or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.9 DEMOLITION AREAS

- A. Demolition work, which generates large amounts of dust, shall be provided with dust control techniques to limit the transport of the airborne pollutants. However, water or slurry used to control dust shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable local, state and federal health and safety regulations.

3.10 SANITARY FACILITIES

- A. The construction site must be provided with adequate sanitary facilities for workers in accordance with Division 1 and applicable health regulations.

3.11 PESTICIDES

- A. The use of pesticides shall be approved by the Owner prior to application. A one-week notice will be required of the Contractor.
- B. Pesticides used during construction shall be stored and used in accordance with manufacturers' guidelines and with local, state and federal regulations. Overuse of pesticides, which could generate contaminated runoff, shall be avoided and great care shall be taken to prevent accidental spillage. Pesticide containers shall never be washed in or near flowing streams or storm water conveyance systems.

3.12 PROTECTION OF TREES IN CONSTRUCTION AREAS

- A. Heavy equipment, vehicular traffic, and stockpiles of construction materials, including topsoil, are not permitted within the dripline of any tree to be retained. Contractor shall avoid all contact with trees to be retained unless otherwise directed by the Owner or required by the work under this Contract.
- B. Specimen trees shown on the Drawings shall be boxed or fenced. When called for in the Drawings, tunnel under the root system for the installation of utility lines.
- C. Tree trunks, exposed roots, and limbs of the trees designated to be retained, which are damaged during construction operations, will be cared for as prescribed by a forester or licensed tree expert at the expense of the Contractor.

3.13 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION

SECTION 01 57 23 - FILTER FABRIC FENCE

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the installation of erosion and sedimentation control filter fabric fences (FFF) utilized during construction. The filter fabric fences are to be used to contain pollutants from overland flow. This practice shall not be used in channelized flow areas.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

- A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
- D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

- A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabric.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

- A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of the disturbed soil. Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: Mirafi Inc. or preapproved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and set out in this Section.
- B. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

- C. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.
- D. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.
- E. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.
- F. Contractor shall employ protective measures described in Section 01560 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

- A. Provide filter fabric fence systems at locations shown on the Drawings in accordance with the Detail at the end of this Section or on the Drawings, entitled "Filter Fabric Fence". Filter fabric fence systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the filter fabric to 1 inch by 2 inch wooden stakes spaced a maximum of 3 feet apart and embedded in the ground a minimum of 1 foot. If factory preassembled fence with support netting is used, spacing of the post may be increased to 8 feet maximum. The wooden stakes shall be installed at a slight angle toward the source of anticipated runoff.
- C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow or for V-trench configuration as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.
- D. Filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.
- E. The filter fabric should be provided in continuous rolls and cut to the length of the Silt Fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6 inch overlap, and sealed securely.
- F. Inspect sediment filter fabric fence systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the fence in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION

SECTION 01 57 24 - REINFORCED FILTER FABRIC BARRIER

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the installation of erosion and sedimentation control of reinforced filter fabric barriers (RFB) which must be utilized during construction. Reinforced filter fabric barrier is to be utilized to retain pollutants from passing downstream in channelized flow areas.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

- A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
- D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

- A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabrics.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

- A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of upstream disturbed soils. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: Mirafi, Inc. or preapproved equivalent.
- B. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the

requirements shown on the Drawings and specified in this Section. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

- B. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.
- C. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.
- D. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately. Contractor shall employ protective measures described in Section 01560 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

- A. Provide reinforced filter fabric barrier systems at locations specified on the Drawings in accordance with the Detail, found at the end of this Section or on the Drawings, entitled "Reinforced Filter Fabric Barrier". Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the woven wire support to steel fence posts (min. of 1.25 lbs. per linear foot & Brinell Hardness greater the 140) or 1-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Steel post shall be made of hot rolled steel, at least 4 feet long with Tee or Y-bar sections with the surface painted or galvanized. Provide safety caps on top of metal posts. The posts shall be installed at a slight angle toward the source of the anticipated runoff.
- C. Trench in the toe of the reinforced filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow as shown on Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.
- D. Reinforced filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.
- E. The filter fabric should be provided in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with minimum 6-inch overlap and sealed securely.
- F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace the damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the barrier in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water

Pollution Prevention Plan.

END OF SECTION

SECTION 01 57 25 - STABILIZED CONSTRUCTION EXIT

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the installation of erosion and sedimentation control for stabilized construction exits utilized during construction and prior to the final development of the site.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. ASTM D 4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

- A. Manufacturer's catalog sheets and other pertinent information on geo-textile fabric.
- B. Sieve analysis of aggregates conforming to requirements of this Section.

PART 2 - PRODUCTS

2.1 SEPARATION GEOTEXTILE

- A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632) and the equivalent opening size between 50 and 140, with the appropriate opening size to be approved in the review process based on the characteristics of the disturbed material. Both the geotextile and threads shall be resistant to chemical attack, mildew and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: Mirafi Inc. or preapproved equivalent.

2.2 COARSE AGGREGATES

- A. Coarse aggregates shall consist of crushed stone, gravel, crushed blast furnace slag, or combinations thereof. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

- B. Coarse aggregates shall conform to the following gradation requirements.

<u>Sieve Size</u> <u>(Square Mesh)</u>	<u>Percent Retained</u> <u>(By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

PART 3 - EXECUTION

3.1 GENERAL

- A. To keep the street clean of mud generated by construction vehicles and equipment, Contractor shall provide stabilized construction exits at the construction site, staging, parking, storage, and/or disposal areas. Such erosion and sediment control system shall be constructed in accordance with the Detail - Stabilized Construction Exit attached hereto or shown on the Drawings, and any additional requirements shown on the Drawings and set out in this Section.
- B. No clearing and grubbing or rough cutting, other than as specifically directed by the Owner to allow soil testing and surveying, shall be permitted until erosion and sedimentation control systems are in place.
- C. Maintain existing erosion and sedimentation control systems located within the project site until acceptance of the project or until directed by the Owner to remove and discard the existing system.
- D. Regularly inspect and repair or replace components of stabilized construction exists. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials offsite.
- E. Remove and dispose sediment deposits at the project designated spoil site. If a project spoil site is not designated on the Drawings, dispose of sediment offsite at location not in or adjacent to stream or floodplain. Off-site disposal will be the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local rules and regulations.
- F. Equipment and vehicles of the Contractor, or on-site for his use, shall be prohibited from maneuvering on areas outside of the construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.
- G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the Section 01560 - General Source Controls.

3.2 CONSTRUCTION METHODS

- A. Provide stabilized exits, entrances, access roads, parking areas, and other on-site vehicle transportation routes where shown on the Drawings.
- B. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to

entrance onto area roadways. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas, which drain into a drainage system protected by erosion and sediment control measures.

- C. Details for stabilized construction exit are shown on the Detail herein or as shown on the Drawings. Construction of other stabilized areas shall be to the same requirements. Roadway width shall be at least 30 feet and shall be sufficient for all ingress and egress to the site. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlaying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of fourteen days to minimize damage potential.
- D. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sand bags, gravel, boards, or similar methods to prevent sediment from entering area roadways, receiving stream or storm water conveyance system.
- E. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto area roadways shall be remove immediately.
- F. The length of the stabilized area shall be as shown on the Detail or as shown on the Drawings, but not less than 50 feet in length. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.
- G. Stabilization for other areas shall have the same thickness, and width requirements as the stabilized construction exit, except where specified otherwise on the Drawings. The aggregate shall be a compacted limestone base material, 8 inches in thickness, with an application of emulsified asphalt. The emulsified asphalt material shall be reapplied periodically following any regrading of the limestone surface.
- H. Stabilized area may be widened or lengthened to accommodate truck-washing area as required by the Contractor and approved by the Owner.
- I. Alternative methods of construction, when preapproved by the Owner, may include the following.
 - 1. Cement Stabilized Soil - Compacted cement stabilized soil or other fill material in an application thickness of at least 8 inches.
 - 2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge to edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.
 - 3. Steel Mats - Perforated mats placed across perpendicular support members.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this Section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION

SECTION 01 57 26 - TEXAS POLLUTION DISCHARGE ELIMINATION SYSTEM (TPDES)

PART 1 - GENERAL

1.1 SCOPE

- A. This project is subject to the Texas Commission on Environmental Quality (TCEQ) Texas Pollution Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements. The Contractor will be required to execute a Notice of Intent (NOI) and implement the Pollution Prevention Plan included in the Contract Documents and comply with all reporting and inspection requirements set forth in the TPDES regulations.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Supplementary Conditions, and relevant Division 2 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. The Contractor shall be responsible for the preparation, implementation, maintenance, and inspection of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking and other practices described in the Storm Water Pollution Prevention Plan (SWPPP) Drawing, and as specified elsewhere in this or other Technical Specifications.
- B. Contractor shall present his plan for implementation of the SWPPP in a meeting with the Owner/Architect/Engineer prior to start of construction.

1.4 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. The components shall consist of the control measures necessary to comply with the NPDES and The Clean Water Act. Example erosion and sediment control measure components are found on the Storm Water Pollution Prevention Plan Drawing, and this or other Technical Specifications.

PART 3 - EXECUTION

3.1 NOTICE OF INTENT / CERTIFICATION REQUIREMENTS

- A. The Contractor shall execute, along with the Contract Documents, a Contractor/Subcontractor Certification, which shall identify the responsibilities for construction activity during the contract. Each Subcontractor's responsibility with regard to the SWPPP shall be identified.
- B. The Contractor shall be responsible for signing the certification statement of the NOI.
- C. A copy of the NOI shall be posted in a prominent place for public viewing at the project site. The Contractor shall be responsible for execution of all documents and providing all inspections and certifications outlined in the SWPPP as necessary for compliance with federal, state and local guidelines.

- D. The executed Notice of Intent shall be sent to:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC-228
P.O. Box 13087
Austin, Texas 78711-3087

3.2 RETENTION OF RECORDS

- A. The Contractor shall retain a copy of the SWPPP from the date that it became effective to the date of project completion.
- B. Contractor shall retain copies of all inspection and maintenance reports, as well as copies of all modifications and adjustments to the SWPPP until the date of project completion.
- C. Contractor shall return to the Owner, all records stated above at the completion of the project. Owner will retain all SWPPP records and data for a period of three (3) years from the date project completion.

3.3 REQUIREMENTS

- A. The following notices are to be posted from the date that the SWPPP goes into effect until the date of final stabilization:
 - 1. Copies of the Notice of Intent, submitted by the Owner and General Contractor, along with the Project Description Form of the SWPPP, are to be posted at the construction site or at the Contractor's office in a prominent place for public viewing.
 - 2. Notice to drivers of equipment/vehicles to stop, check, and clean tires for debris and mud before equipment/vehicles can enter traffic lanes are to be posted at every stabilized construction exit area.
 - 3. Notice of waste disposal procedures are to be posted at a location onsite.
 - 4. Notice of hazardous material handling and emergency procedures are to be posted with the NOI on site. Copies of Material Safety Data sheets are to be kept at a location onsite that is clearly made known to all personnel.
 - 5. A copy of the signed Certification forms included in this Section shall be kept at the construction site or at the Contractor's office.
- B. Construction may not begin until 60 days after the NOI is filed.
- C. Construction sites that will disturb 10 acres or more shall meet current numeric discharge limit requirements.
- D. If earth disturbance will be stopped for 14 days or more, the contractor must immediately stabilize the area using straw or hydraulic mulch, soil binders, erosion control blankets, or hydroseeding.

3.4 NOTICE OF TERMINATION

- A. A Notice of Termination (NOT) of Coverage under the TPDES General Permit for Storm Water Discharges Associated with Industrial Activity and storm water run-off from the construction activities does not cause sediment transport or erosion from the site. The A/E and inspector will make final determination of the final stabilization. Final stabilization is when all soil-disturbing activities at the site have been completed and when a uniform perennial vegetative cover with a density of 85% of the cover for unpaved areas has been established. The Contractor will be required to maintain structural controls until this vegetative cover meets the above requirement.

3.5 ATTACHMENTS

For the current forms, visit the TCEQ's website at:

<https://www.tceq.texas.gov/assistance/water/stormwater/sw-construction.html#tpdes>.

END OF SECTION 01 57 13.15

SECTION 01 71 23 - FIELD ENGINEERING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Measures to ensure adequate quality control and quality assurance for all Work in accordance with Conditions of the Contract, as specified herein, and with the quality control and quality assurance requirements of each Specification Section, and authorities having jurisdiction.

1.2 RELATED SECTIONS

- A. All Sections of Work requiring layout, survey, reference points and their verification and protection, and quality control and assurance monitoring requirements.

1.3 DEFINITIONS

- A. Survey and Field Engineering: Wherever the terms "Survey", "Field Engineering" or any derivative thereof, or similar term appears within this Section, they mean one and the same, and shall mean the survey or field engineering work performed by the Field Engineer as defined below and is separate from that of the survey work provided by the Owner.
- B. Field Engineer: Wherever the term "Field Engineer" or any derivative thereof, or similar term appears in the Contract Documents, it shall refer to the General Contractor's employee(s) that are expert in, routinely engaged in, and have at least five (5) years experience in, the practice of construction project field engineering, building and project layout, construction measurements and monitoring, etc.
- C. "Construction Surveyor": Wherever the term "Construction Surveyor", or any derivative thereof, or similar term appears in the Contract Documents, the entity (person or firm) licensed as a Registered Professional Land Surveyor or Professional Engineer of the discipline required for specific service on the Project in the State in which the Project occurs, with five (5) years minimum experience, and meeting all applicable regulations of the State in which the Project occurs and Department of Labor, and other authorities having jurisdiction to perform the Work. To avoid any misunderstanding or lack of interpretation, the entity responsible for performing the Work of this Section shall be employed by the General Contractor, and the responsibility, including methods and means, is totally that of the General Contractor.
- D. Quality Control and Quality Assurance: Wherever the terms "Quality Control", "Quality Assurance" or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean an aggregate of activities of the General Contractor, such as design analysis and statistical sampling with inspection for defects, designed to ensure adequate quality in materials and workmanship whether factory manufactured or jobsite produced.

1.4 QUALITY CONTROL AND QUALITY ASSURANCE

- A. Employ a Construction Surveyor complying with the definition above and acceptable to the Owner and Architect, to perform all Construction Surveying. Provide full responsibility for the Construction Surveyor and accuracy of the performance of all items of Work shown on Drawings, specified herein, or in other Specification Sections.

1.5 SUBMITTALS FOR REVIEW

- A. Submit name, address, telephone number, fax number, and registration number of the proposed Construction Surveyor prior to starting Work of this Section.
- B. Submit evidence of Construction Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate, if different from Construction Manager's.
- C. Upon request by Architect, submit documentation verifying accuracy of all Survey Work, including a certificate sealed and signed by the Construction Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents and such information has been incorporated into the Project Record Documents.
- D. Submit Project Record Documents under provisions of Section 01 77 00, Closeout Procedures.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

- A. Locate and protect survey control and reference points.
- B. Control datum for survey is that established by the Owner provided survey and as indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original Owner's survey control. Make no changes without prior written permission of Architect.

3.3 FIELD ENGINEERING AND CONSTRUCTION SURVEYOR REQUIREMENTS

- A. Establish a minimum of two (2) permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Field Engineer shall establish elevations, lines and levels. Locate, lay out, and monitor by instrumentation and similar appropriate means Work, including, but not be limited to:
 - 1. elevations, and layout of property lines and easements;
 - 2. site drainage, including storm water control and pollution prevention measures, slopes, swales, and invert elevations;
 - 3. limits of clearing and grubbing, including identification of trees and planting to be removed and methods for protection of those to remain;

4. excavations, fill and topsoil placement, and all (rough and finish) grades;
 5. trenching and trench safety;
 6. utility locations;
 7. concrete and asphaltic concrete paving, curbs, ramps, and other site improvements, as applicable;
 8. grid or axis for structures, batter board locations;
 9. elevation, grade controls, and layout of building foundation and grade beams, column locations, base plates, embedded items, depressions, formwork, and openings in concrete, including all interior finish grades;
 10. elevations of structural steel, including, steel joists/trusses, steel decks, and associated miscellaneous metals;
 11. elevations and layout of masonry, including concrete masonry units (CMU), face brick, cast stone, and other elements built-in masonry.
 12. elevations and slopes of roofing, including those for lightweight insulating concrete deck system, if applicable.
 13. elevations and layout of work as required to ensure proper operation, clearances, and tolerances, including conveying systems, plumbing and mechanical work; and
 14. monitoring of movement and protection of existing or adjacent structures, as applicable.
- C. Throughout course of Work, verify existing conditions and layouts by same means as originally used to ensure conformance with design requirements and details. Notify Architect immediately, if discrepancies are found.
- D. Provide one (1) copy each of reduced Field Engineer's notes to the Architect, Owner, Construction Surveyor, and affected Consultant within four (4) working days of completion of each portion of the Field Engineering Work.
- E. Field Engineer's notes shall be clear and complete. The Field Engineer shall be available at no expense to the Owner, Architect, or Consultants for note interpretation, if required.
- F. Field Engineer shall perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- G. Provide Construction Surveying services. Utilize recognized engineering survey practices.
- H. Construction Surveyor shall verify and record/document their findings, on a drawn survey at a scale matching that of the original Contract Documents, for the following:
1. All property lines and corners
 2. All building corners
 3. All paving corners
 4. Finish floor of all/each buildings
 5. Invert elevations, flow lines for all site drainage structures and improvements
- I. Payment for earthwork quantities shall be for materials in place, compacted, and determined by neat line method.
- J. Provide the Owner a reproducible hard copy and digital/electronic file copy of all the Construction Surveyor's work.

3.4 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and Field Engineer work as it progresses.
- B. Upon completion of Work, including, but not limited to earthwork, formwork, foundation, structural steel erection, and major site improvements, prepare Project Record Documents illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Project Record Documents as specified in Paragraph 1.5.

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair Work required to restore construction to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the State of Texas, who is experienced in providing land surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.

- B. In Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as necessary to locate each element of Project.
 - 2. Establish limits on use of site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical Work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions ensuring the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous. Materials containing asbestos and BCPs are prohibited.

3.6 OWNER INSTALLED PRODUCTS

- A. Site Access: Provide access to site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's Work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning

materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with mechanical, plumbing, and electrical requirements.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 SUBMITTALS

- A. Waste Management Plan: Submit plan within 10 days of date established for commencement of the work.
- B. Waste Reduction Progress Reports:
 - 1. Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
 - a. Material category.
 - b. Generation point of waste.
 - c. Total quantity of waste in tons (tonnes).
 - d. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 - e. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 - f. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - g. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

- C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end of Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Firm having minimum 10 years documented experience in specializing in waste management coordination.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Waste Management Conference:
 - 1. Conduct conference at site. Review methods and procedures related to waste management including, but not limited to, the following:
 - a. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - b. Review requirements for documenting quantities of each type of waste and its disposition.
 - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - e. Review waste management requirements for each trade.

1.6 PERFORMANCE REQUIREMENTS

- A. Conform to County regulations regarding Solid Waste Control.
- B. Achieve end of Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and

salvage of materials:

1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - l. Rough hardware.
 - m. Roofing.
 - n. Insulation.
 - o. Doors and frames.
 - p. Door hardware.
 - q. Windows.
 - r. Glazing.
 - s. Metal studs.
 - t. Gypsum board.
 - u. Acoustical tile and panels.
 - v. Carpet.
 - w. Carpet pad.
 - x. Demountable partitions.
 - y. Equipment.
 - z. Cabinets.
 - aa. Plumbing fixtures.
 - bb. Piping.
 - cc. Supports and hangers.
 - dd. Valves.
 - ee. Sprinklers.
 - ff. Mechanical equipment.
 - gg. Refrigerants.
 - hh. Electrical conduit.
 - ii. Copper wiring.
 - jj. Lighting fixtures.
 - kk. Lamps.
 - ll. Ballasts.
 - mm. Electrical devices.
 - nn. Switchgear and panelboards.
 - oo. Transformers.
2. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Carpet and pad.
 - i. Gypsum board.
 - j. Piping.
 - k. Electrical conduit.
 - l. Packaging - Regardless of salvage/recycle goal indicated in "General" Paragraph

above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

- 1) Paper.
- 2) Cardboard.
- 3) Boxes.
- 4) Plastic sheet and film.
- 5) Polystyrene packaging.
- 6) Wood crates.
- 7) Plastic pails.

1.7 WASTE MANAGEMENT PLAN

- A. Develop a waste management plan and requirements. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan:
 1. List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures:
 - a. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - b. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - c. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - d. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - e. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - f. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis:
 1. Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:
 - a. Total quantity of waste.
 - b. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 - c. Total cost of disposal (with no waste management).
 - d. Revenue from salvaged materials.
 - e. Revenue from recycled materials.
 - f. Savings in hauling and tipping fees by donating materials.

- g. Savings in hauling and tipping fees that are avoided.
- h. Handling and transportation costs. Include cost of collection containers for each type of waste.
- i. Net additional cost or net savings from waste management plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

- A. Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract:
 - 1. Comply with operation, termination, and removal requirements in Section 01 50 00.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training:
 - 1. Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work:
 - a. Distribute waste management plan to everyone concerned within three (3) days of submittal return.
 - b. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls:
 - 1. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities:
 - a. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - b. Comply with Section 01 50 00 for the control of dust and dirt, environmental protection, and noise control.
- E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the work:
 - 1. Salvage items for reuse and handle:
 - a. Clean salvaged items.
 - b. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - c. Store items in a secure area until installation.
 - d. Protect items from damage during transport and storage.
 - e. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use:
 - 1. Salvage items for Owner's use and handle as follows:
 - a. Clean salvaged items.
 - b. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - c. Store items in a secure area until delivery to Owner.
 - d. Transport items to Owner's storage area designated by Owner.
 - e. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors, unless otherwise designated by Owner.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING WASTE

- A. Recycle paper and beverage containers used by on site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures:
 - 1. Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan:
 - a. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin:
 - 1) Inspect containers and bins for contamination and remove contaminated materials if found.
 - b. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - c. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - d. Store components off the ground and protect from the weather.
 - e. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 DISPOSAL OF WASTE

- A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction:
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

3.5 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste
- H. Form CWM-8 for demolition waste.

CWM Forms Follow

FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION

MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

FORM CWM-2: DEMOLITION WASTE IDENTIFICATION

MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				

FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mechanical Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00, Project Coordination and Management.

1.3 SUBSTANTIAL COMPLETION

- A. The items listed in the Supplementary Conditions, Paragraph 9.8 and the following items shall be completed before Substantial Completion will be issued:
 - 1. Contractor's (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work. The Architect/Engineer's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
 - 2. Architect's Supplemental Punch List: The Architect/Engineer, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
 - 3. Operations and Maintenance Manuals: Submit as described in paragraph 1.3.
 - 4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in paragraph 1.6 and 1.7.
 - 5. Starting of systems: Start up equipment and systems as described in paragraph 1.8.
 - 6. Testing and balancing: Testing and balancing of systems must be performed and completed and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
 - 7. Demonstrations: If required by individual specification sections or by Owner, provide demonstrations and instructions for use of equipment as described in paragraph 1.9.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.4 PUNCH LIST

- A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of Work to be

completed, if any. This list is intended to represent a limited number of items needing attention.

- B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
 - 1. Room number or other suitable location identifier
 - 2. Description of the work
 - 3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 - 4. Sub-contractor/trade sign-off date
 - 5. General contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 - 6. General contractor/trade sign-off date
 - 7. A/E consultant sign-off
 - 8. A/E consultant sign-off date
 - 9. If requested by the Owner, provide two additional similar columns for their sign-off.
 - 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the contractor/sub-contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.
- C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for re-inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.
- D. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.
- E. The Contractor's superintendent shall participate in the preparation of the Contractor's punch list that is submitted to the Architect and Owner for supplementation. Upon receipt, the Architect and Consultants shall perform a spot review to determine the adequacy and completeness of the Contractor's punch list.
- F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany the Architect, his Consultants and the Owner (at his discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
 - 1. The Superintendent shall record or otherwise take note of all supplementary items.
 - 2. The Architect will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the Contractor's receiving said supplements from the Architect will not be cause for a claim for additional cost or extension of time as the Contractor's Superintendent shall have been in attendance during the inspections of the Architect and his Consultants and will have been expected to take his own notes.

1.5 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to and reviewed and accepted by the Architect prior to issuance of the Certificate.
- B. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.

- C. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, etc.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Equipment start-up instructions
 - e. Operating instructions.
 - f. Maintenance instructions for equipment and systems.
 - g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Product data.
 - b. Air and water balance reports.
 - c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- G. Submit one (1) final original and two (2) copies to Architect. The final original will be delivered to the Owner.
- H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by the Architect, Consultants and Owner: closeout manual, MSDS binder, O&M Manuals, specifications and approved submittals. Documents shall be hyper-linked to the Table of Contents.

1.6 PROJECT CLOSEOUT PROCEDURES

- A. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
 - 1. Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to the Supplementary Conditions, Paragraph 9.10 for additional information.
 - 2. Record Documents: Submit as described in paragraph 1.10.
 - 3. Extra materials: Provide extra stock, materials, and products as described in paragraph 1.11 when required by individual specification sections.
 - 4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
 - 6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.

7. Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.

1.7 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Supplementary Conditions of the Contract.
- B. Prepare 3-ring D-slant binder cover and spine with printed title "CLOSEOUT DOCUMENTS", title of project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and Owner. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.
- E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Document AD.
 2. Part 2: Closeout Documents and Affidavits, include the following:
 - a. AIA G707 - Consent of Surety to Final Payment;
 - b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;
 - c. AIA G706A - Contractor's Affidavit of Release of Liens;
 3. Part 3: Project documents and certificates, including the following:
 - a. Copy of Certificate of Substantial Completion (AIA G704);
 - b. Copy of All Permits;
 - c. Copy of Final Utility Bill or letter of transfer;
 - d. Copy of Certificate of Occupancy;
 - e. Copy of Certification of Project Compliance: Submit on attached **Close-out Form "B"**. Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established. (Owner to be provided original separately);
 4. Part 4: Warranties, Release of Liens, compile sequentially based on specification sections:
 - a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work;
 - b. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached **Close-out Form "A"** – Subcontractor's Affidavit of Release of Lien.
 - c. Hazardous Material Certificate: Submit on attached **Close-out Form "C"**. Affidavits from Contractor, Subcontractors and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project.
 - d. Subcontractor's Warranty: notarized and submitted on attached **Close-out Form "D"**. This Warranty shall state all sections of Work performed by the subcontractor and warranty period.

- e. Special / Extended Warranties; List and provide, notarized warranties requested by Owner, or required by or incorporated in the Contract Documents.
 - f. Spreadsheet depicting all items and materials that carry a warranty longer than one (1) year. Include information consisting of material/ supplier/ installer/ specification section/ length of warranty and contact information.
5. Part 5: Receipts:
- a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below. Receipts must be signed by an authorized Owner's representative;
 - b. Keys: Provide original receipts for delivery of "Keys". Receipts must be signed by an authorized Owner's representative.
 - c. Sign in sheets: provide signatures of attendees from all demonstrations.
- F. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

1.8 FINAL CLEANING

- A. Execute final cleaning prior to final project inspection and acceptance.
- B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
- C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
- D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- E. Clean and replace filters of operating equipment as required by Contract Documents
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.9 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

- F. Prohibit traffic from landscaped areas.

1.10 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.
- G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.11 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner's requirements.
- B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- D. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.
- F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.
- G. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with Owner.
- H. All demonstrations are to be documented by video and submitted to the Owner in DVD format along with the close out documents. General contractor is responsible for all video and compilation onto DVD with linked menus.

1.12 PROJECT RECORD DOCUMENTS

- A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect and Engineers is achieved in accordance with the Owners requirements.

1.13 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site or to District Maintenance Department as directed by Owner; obtain signed receipt from Owner's authorized representative prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner's authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.
- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

1.14 WARRANTIES, CERTIFICATES AND BONDS

- A. Definitions:
 - 1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
 - 2. Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under Paragraph 3.5 of the General Conditions as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractor's one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.
- C. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under Paragraph 12.2 of the General Conditions.
- D. No service charges or call out charges are allowed to investigate warranty claims.
- E. In addition to the Contractor's one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.
- F. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- G. Warranty Requirements:
 - 1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 4. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- H. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warrantees with Closeout Documents submitted to the Architect.

1.15 FINAL COMPLETION AND FINAL PAYMENT

- A. Final Notice and Inspection:
1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to the Architect that the Work is ready for final inspection and acceptance.
 2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, the Architect and Engineer will make final inspection.
- B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
- C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.
- D. Release of Retainage: Release of retainage will not be authorized by the Architect until Contractor completes all requirements for close-out to the satisfaction of the Owner and Architect as described herein.

1.16 TERMINAL INSPECTION

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.
- B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.

- C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

PART 4 – SCHEDULE

Item	Date of Issue
Schedule of Closeout Conference	180 days before Substantial Completion
Operations & Maintenance Manuals	60 Days before Substantial Completion
Contractor's Punch List	Include with formal request for Substantial Completion.
As-Builts	30 Days after Substantial Completion
Affidavits	30 Days after Substantial Completion
Release of Liens	60 Days after Substantial Completion
Testing and Balance Report	60 Days after Substantial Completion
Warranty Forms	60 Days after Substantial Completion

END OF SECTION 01 77 00

SECTION 01 77 00 CLOSEOUT FORMS

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF TEXAS

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

Project: **Tomball HS Athletic Improvements**

Owner: **Tomball Independent School District** Architect: **DIG Engineers**

Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.
3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.
4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

Name of Subcontractor

Secretary

(By)

(Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

CLOSE OUT FORM "B"

**CERTIFICATION
OF PROJECT
COMPLIANCE**

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

DISTRICT: Tomball Independent
School District

Facility:

ARCHITECT/ENGINEER: DIG
Engineers

Address:

CONTRACTOR/CM:

City:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT: Tomball HS Athletic Improvements

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: Katy Independent School District **BY:**

DATE:

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER: DIG Engineers

BY:

DATE:

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM:

BY:

DATE:

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

DISTRICT: Tomball Independent School District

BY:

DATE:

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:

- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1033 or §61.1036, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____ PROJECT: **Tomball HS Athletic Improvements**

COUNTY OF _____ OWNER: Tomball **Independent School District**

ARCHITECT: **DIG Engineers**

SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she
is the

_____ of _____, the subcontractor / supplier
who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized
to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing
products have been incorporated into the project.

ATTEST (If Corporation)

Name of Subcontractor / Supplier

(Title)

Secretary (By)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____ of _____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

Project: **Tomball HS Athletic Improvements**

Owner: **Tomball Independent School District** Architect: **DIG Engineers**

Work Performed: _____ Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.
4. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows: _____

ATTEST (If Corporation)

Name of Subcontractor

Secretary

(By)

(Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect or by uploading to web-based project software site or by email to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.

4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures,

maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for project record documents, including but not limited to:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings:
 - 1. Number of Copies: Submit one set of marked up record prints.
 - 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and one annotated PDF electronic file and directory of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

- A. Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference.
 - 1. Do not use As Built Drawings and Specifications for Record Drawings and Specifications.
- B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.
- C. Store Record Documents and samples apart from as built documents used for construction.
 - 1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document *PROJECT RECORD* in neat, large, printed letters.
 - 2. Maintain Record Documents in clean, dry and legible condition.
 - 3. Make Record Documents and samples available for inspection upon request of Architect.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally.
 - a. Give attention to information on concealed elements difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross reference record prints to corresponding shop drawings or archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.

4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation PROJECT RECORD DRAWINGS.
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 RECORD SAMPLES

- A. Record Samples: Determine with Architect and Owner which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
1. Reviewed shop drawings, product data, and samples.
 2. Field test reports.
 3. Inspection certificates and manufacturer's certificates.
 4. Inspections by authorities having jurisdiction (AHJ).
 5. Documentation of foundation depths.
 6. Special measurements or adjustments.
 7. Tests and inspections.
 8. Surveys.
 9. Design mixes.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
 - 4. O&M Manuals should be uploaded into Owner's designated software (Prolog)

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date of video recording.
 - 2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.

- c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.

2. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner through Program Manager with at least 10 days' advance notice.
- C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

END OF SECTION 01 79 00

SECTION 02 32 00 - GEOTECHNICAL REPORT

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 THE FOUNDATION INVESTIGATION REPORT

- A. The geotechnical report is as follows:
 - 1. Subsurface Investigation:
 - a. Entitled: Tomball ISD High School Athletic Improvements
 - b. Prepared for: Tomball ISD
 - c. Prepared by: Terracon
- B. The boring plans, results of laboratory tests, and description of stratum for each test hole are enclosed in this Section.
- C. The Contractor is hereby advised to review the geotechnical report and visit the site to ascertain the conditions affecting the work. In the event of discrepancies between the drawings, specifications and geotechnical report, the contractor shall bring to the attention of the architect for resolution. In the absence of a Geotechnical Report, discrepancies between Drawings and Specifications shall be brought to the attention of the Architect for resolution. Failure to review the geotechnical report and report discrepancies, between the geotechnical report, if any, and drawings and specifications, to the Architect will not relieve the Contractor from the responsibility to perform the work required by such documents, at no additional expense to the Owner.

1.2 SOIL CONDITIONS

- A. The conditions indicated in the report were known to exist at the location shown on the date the tests were performed; however, these boring logs are for the Contractor's consideration only, and he shall visit the site and fully acquaint himself with the existing conditions and be prepared to complete all work required by the documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 02 32 00

SECTION 02 41 13 - SELECTIVE DEMOLITION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Partial demolition of existing building as required to accommodate additions and renovations as shown on the drawings or required. Include removal of existing utilities as indicated or encountered; removal of masonry, and mechanical, electrical, and plumbing items as indicated or required.

1.2 SUBMITTALS

- A. Submit the following items.
 - 1. Itemized Demolition Schedule.
 - 2. Detail all demolition methods to be used.

1.3 PERMITS

- A. Procure and pay for all necessary permits or certificates required to complete the work specified. Make any and all required notifications and comply with all applicable Federal, State and local ordinances.

1.4 QUALITY ASSURANCE

- A. Provide at least one (1) person who shall be present and in charge of the Demolition Work at all times and who shall be thoroughly familiar with all phases of all work performed under this Section.
- B. Comply with all pertinent codes and regulations applying to this work.

1.5 JOB CONDITIONS

- A. Use all means necessary to prevent the spread of dust during performance of this work. Provide additional clean filters for the existing air handling system serving those areas to remain to protect them from construction dust.
- B. Use all means necessary to protect the existing building to remain from all types of damage, including fire, water damage, and unnecessary interruption of utility services. In the event of damage of any kind, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.
- C. Motor driven equipment shall have functional mufflers.
- D. Visit the site and examine the existing structure. Note all conditions as to the character and extent of work involved.

1.6 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 - Notification of Architect requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all barricades, shoring, and bracing necessary to protect the tenants, workmen, and Public from danger. Barricades shall be sufficiently designed to protect and or exclude the public from all hazards.
- B. All other materials, not specifically described but required for proper completion of Work of this Section, shall be as selected by the Contractor subject to the approval of the Owner.
- C. The Owner and Architect are not responsible and make no claims for the quality or quantity of the materials being demolished. The General Contractor or subcontractors that undertake or assume the benefits of salvage efforts shall assume all risks associated with that effort.

2.2 DEMOLITION WORK

- A. Perform demolition work in manner so as to allow Owner's safe use of existing facility.
- B. Perform demolition work in order to maintain Owner's construction schedule.

2.3 REMOVAL OF PARTITIONS, COLUMNS AND STRUCTURE

- A. Masonry walls or other sections of masonry shall not be permitted to fall on floors of building in masses to exceed safe carrying capacity of floors. Existing floors shall be properly protected with plywood on both sides of a partition to be demolished.
- B. Provide temporary shoring or bracing wherever necessary for the protection of occupants, workmen, walls, partitions, roofs, floors and structure to remain.
- C. Structural or load-supporting members shall not be cut or removed adjacent to existing structures to remain until all loads carried by members have been removed or adequately supported.
- D. No masonry walls shall be removed until it has been determined that the walls to be removed do not support the roof. To determine this, all adjacent materials such as finish ceilings shall be removed to provide adequate views of existing structure. Provide temporary shoring as needed. The Contractor shall take all precautions necessary to ensure the safety of the demolition workers and all occupants of the building.
- E. No demolition will be allowed above, below, adjacent to or near any occupied areas of the building.
- F. Where access holes in existing ceilings or removal of existing ceilings are required, minimize the access in order to minimize the repair work and repair or replace removed or damaged work to match adjacent undamaged work.
- G. Cut and tooth new openings in masonry where required, of correct size to permit installation of frames and anchors for new doors.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Before commencing the Work of this Section, verify with the Owner that all items to be removed by the Owner have been removed. Schedule the work in a careful manner with all necessary

consideration for the Public and the Owner. All items of existing equipment and materials or any other item of value to the Owner shall be salvaged by the Owner prior to demolition.

- B. All material removed under this Contract, which is not to be salvaged or reused, shall become the property of the Contractor and be promptly removed from the site. At all times use movable debris boxes, covered, to convey the material through the building. Do not store or permit debris to accumulate on the site. Dumpsters shall not overflow and shall be emptied on a regular basis. Remove all debris from the building premises and leave the construction site "Clean" each day. All debris shall be dumped in an approved disposal facility and all fees for this shall be paid by the Contractor. Contractor is responsible for completely removing all demolished materials from the site and disposing of them in accordance with all local, State and Federal Regulations. If Contractor fails to remove debris promptly, Owner reserves the right to have debris removed at Contractor's expense.
- C. Conduct operations so as not to interfere with adjacent occupied spaces, roads, streets, drives, walks, service lines and the like.
- D. Keep all pedestrian areas clear for passage at all times.

3.2 PROTECTION OF STRUCTURES, PROPERTY

- A. Execute demolition work to ensure adjacent property no damage from falling debris or other causes.
- B. Take precautions to guard against movement, settlement, or be liable for such movement, settlement, or collapse; repair promptly such damage when so ordered.
- C. Repair damage to Owner's property or any other person or persons on or off premises by reason of required work.

END OF SECTION 02 41 13

SECTION 02 41 19 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 35 91 "Historic Treatment Procedures" for historic removal and dismantling.
 - 3. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 4. Section 01 56 00 "Temporary Jobsite Protection" for temporary protection of architectural items.
 - 5. Section 01 73 00 "Execution" and 01 73 29 "Cutting and Patching" for cutting and patching procedures.
 - 6. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged; or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- E. Deconstruct: To remove by disassembling or detaching an item from the surface, using methods and equipment to successfully prevent damage to the item and surfaces; and dispose of items unless indicated as salvaged or for reinstallation.

1.4 QUALIFICATIONS

- A. Demolition Subcontractor
 - 1. The demolition subcontractor shall meet the following qualification requirements:

- a. The demolition subcontractor company shall have a minimum of five (5) years of demolition and temporary shoring experience of similar size, scale, and complexity of the demolition work involved in this project.
 - b. The site superintendent or foreman shall have the same required experience.
 - c. At a minimum, a demolition subcontractor shall have a representative who has completed OSHA 30 training and be present on site during all demotion and temporary shoring activities.
 - d. Any demolition subcontractors with OSHA violations within the past 5 years or are under active OSHA investigations will not be considered qualified for structural demolition.
 2. In cases where the general contractor wishes to employ multiple demolition subcontractors for various demolition scope, all demolition subcontractors shall meet the above qualifications.
- B. Demolition And Temporary Shoring Delegated Design Engineer
1. The structural EOR is not responsible for the design of any temporary shoring or bracing required between demolition and the installation of the new structure. The demolition and temporary shoring delegated design engineer shall be a licensed professional engineer in the state of Texas who specializes in Demolition and temporary structures. The delegated design engineer is responsible for the following:
 - a. Provide a letter stating that they fully understand the scope of work required from all disciplines.
 - b. Shoring plans and demolition plans, which includes the sequence of shoring, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
 - c. Excavation support and protection system plans, which includes the sequence of support & protection system, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
 - d. Perform periodic site visits which include various milestones for the demolition and shoring subcontractors and shall provide observation report, photos, etc. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed. Measurements shall be taken at milestones.

1.5 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review and finalize protection requirements.
 5. Review areas where existing construction is to remain and requires protection.
 6. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 7. Review procedures for noise control and dust control.
 8. Review procedures for protection of adjacent buildings.
 9. Review items to be salvaged and returned to Owner.

10. Site walk of all areas of selective demolition activities with the delegated design demolition engineer, structural engineer of record, architect, owner, general contractor, and demolition subcontractor representatives overseeing demolition work in attendance.
 - a. GC shall have removed superficial/architectural coverings so that structure is visible during site walk.

1.7 OAC MEETINGS

- A. The General Contractor shall provide a “two-week look ahead” to indicate upcoming areas where demolition work is scheduled to take place, so all parties are aware of timeline and any coordination with architect and consultants can take place. The highlighted plan should be completed by the General Contractor (in conjunction with their demolition subcontractor) and be available for discussion at the weekly OAC meeting.

1.8 SUBMITTALS

- A. For Information Only Submittal: Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- B. For Information Only Submittal: Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services, if any.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 6. Refer to Section 1.7 for “two-week look ahead” requirement at OAC meetings.
- C. For Information Only Submittal: Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Pre-demolition photographs or videos showing existing conditions for any existing walls or new openings in existing walls, floors, and/or roofs scheduled to be demolished for the structural EOR's review and approval prior to the start of demolition. Photos must show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. The locations of pre-demolition photographs & videos shall be identified on an accompanying plan view.
- E. For Information Only Submittal: Demolition Sub-Contractor(s) qualifications required prior to demolition work commencing. Provide the following documentation:
 1. Demolition Subcontractor Company(s):
 - a. Provide the company's project experience in structural demolition for the past 5 years including the scope of work they performed and references with contact information.
 - b. Disclosure of any OSHA violations within the past 5 years and/or any active OSHA investigations.
 - c. Any company name changes for the past 10 years.
 2. Demolition site superintendent(s) / foreman(s)

- a. Provide the names of the structural demolition site superintendent(s) / foreman(s), their project experience for the past 5 years including the scope of work they performed and references with contact information
 - b. Proof of the individuals' completion of OSHA 30 training.
- F. For Information Only Submittal: Demolition & temporary shoring delegated design engineer letter stating they fully understand the scope of work required from all disciplines.
- G. Delegated-Design Submittal: Shoring plans and demolition plans, which includes sequence of shoring, sequence of demolition, and duration of both signed and sealed by the temporary shoring professional engineer responsible for their preparation.
 - 1. Locations for each shoring and demolition event provided in the sequence of shoring and demolition shall be indicated on the shoring and demolition plan to avoid any confusion as to where these activities should occur.
 - 2. These plans shall include the general contractors' field verification comments as described in Section 1.10 Field Conditions.
- H. Delegated-Design Submittal: For temporary shoring system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. This shall be submitted with the shoring and demolition plan delegated-design submittal.
 - 1. Provide a plan with temporary shoring system locations, the amount of load the shoring system will see at each location, the type shoring system used at each location, product data showing the load rating for each shoring tower type used on the project.
- I. For Information Only: Observation reports with site photos for periodic site visits at various demolition and shoring milestones prepared by the demolition and temporary shoring delegated design engineer.
 - 1. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed.
 - 2. Measurements shall be taken at milestones.
- J. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions. Note locations and capping depth of wells and well points.
- K. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.9 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.10 FIELD CONDITION

- A. All existing structure shown on the plans are based on limited existing drawings / as-builts of the existing building, in-person site observations, and assumed framing based on the floor plan layout and may not be entirely accurate, complete, or representative of existing conditions. The general contractor shall not demolish any walls, columns, framing, wall openings, floor openings, or roof openings that are not shown and noted to be demolished on the structural demo plans, regardless of if these items are shown to be demolished on the architectural demo plans or any other disciplines' demo plan without structural engineer-of-record (EOR) review & approval. Care

should be taken during demolition to avoid damaging any structural elements that have been designated to remain.

- B. The general contractor shall field verify the location and size of all structural members shown on the plans prior to beginning any demolition work. Gridlines are shown on the structural drawings, and these reflect assumed architectural and structural dimensions. In most cases, grid lines coincide with existing column and pilaster centerlines. If actual field dimensions, or the location and sizes of existing structural members vary, notify the architect, structural EOR, and demolition & temporary structures delegated design engineer. The contractor shall notify the structural EOR of questionable existing structural components (masonry walls, steel beams and lintels, exposed foundations, etc.) and framing connections when encountered. The contractor shall verify that any wall, masonry or otherwise, to be demolished is a non-load bearing wall prior to beginning demolition. If a wall is found to be load bearing, the contractor shall contact the architect and structural EOR before proceeding.
- C. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- D. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
- E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.11 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- C. LEED Requirements for Building Reuse:

1. Credit MR 1.1 and Credit MR 1.2: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
3. Credit MR 1.2 and Credit MR 1.3: Maintain existing non-shell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 2. Steel Tendons, if any: Locate tensioned steel tendons and include recommendations for de-tensioning.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes as appropriate.
 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.
 - 1. Foundation at new underground plumbing lines: General contractor shall not core through existing grade beams to install new plumbing lines without review and approval from structural EOR. GC shall submit the following information for structural EOR review for new pipe penetrations in existing grade beams:
 - a. Existing grade beam width, depth, and bottom of grade beam elevation in relation to the FFE for grade beams with new pipe penetrations.
 - b. Existing foundation (piers or spread footing) locations supporting the existing grade beams with new pipe penetrations.
 - c. The planned pipe penetration opening size and the elevation of the center of the new opening in relation to the FFE.
 - d. The planned pipe penetration opening location in relation to the nearest foundation on both sides of the opening.
- D. Existing foundation demolition:
 - 1. At any location where a new foundation will overlap an existing foundation
 - a. The soil currently in the existing foundation shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. If foundations are planned to be excavated and completely removed, the geotechnical engineer should be contacted for additional recommendations.
 - 2. At any location where an existing footing/pier does not overlap with a new pier:
 - a. The portion of the existing footing/pier within 1-ft of bottom of new grade beams shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698).
 - 3. While it is common for the testing and inspections laboratory to be involved and on-site during earthwork prep. and operations; (including but not limited to: observing and testing earthwork properties, select fill properties, thicknesses, compaction, moisture content, etc.) We also require the testing and inspections laboratory to be on-site for the infill of any and all demolished foundation items, both partially and fully demolished. We have observed instances where the demo contractor did not properly/adequately infill the sub-grade voids and/or compact the infill from existing demolished foundations. When the new building was constructed, the inadequate fill/compaction led to water intrusion problems and questionable bearing. We require that the testing and inspections laboratory be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved.
 - a. The owner shall be aware that this additional testing inspection scope will be required.
 - b. The general contractor shall inform the demolition contractor(s) that the infill of the demolished foundations will be required to meet the earthwork requirements and be testing for compliance and any additional cost associated with ensuring the infill meets these parameters shall be included in their base bid.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill unless otherwise directed by Owner.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 05 80 - UNDER-SLAB VAPOR BARRIER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Products Supplied Under This Section
 - 1. Vapor Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.
- B. Related Sections
 - 1. Section 03 30 00 Cast-in-place Structural Concrete
 - 2. Section 01 45 23 Structural Testing and Inspection

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Barriers Used in Contact with Soil or Granular Fill Under Concrete Slabs
 - 2. ASTM E 154-88 (2005) Standard Test Methods for Water Vapor Barriers Used in Contact with Earth Under Concrete Slabs
 - 3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
 - 4. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Barriers Used in Contact with Earth or Granular Fill Under Concrete Slabs
- B. American Concrete Institute (ACI)
 - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.4 SUBMITTALS

- A. Quality Control / Assurance
 - 1. Full set of test results as per paragraph 8.3 of ASTM E 1745.
 - 2. Manufacturer's samples, literature
 - 3. Manufacturer's installation instructions for placement, seaming and pipe boot installation.

1.5 SUBSTITUTIONS

- A. Product Review
 - 1. Request must be made 14 days prior to bid date to allow time for proper review. Reviews will be at contractor's expense.
 - 2. Independent laboratory test results showing compliance with ASTM E 1745 Class A, a permeance less than 0.01 Perms (grains/(ft² *hr * in. Hg) before and after the mandatory

conditioning tests ASTM E 154 Sections 8,11,12, and 13. (Woven, and recycled plastics are not permitted)

3. Incomplete substitutions will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vapor Barrier (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision. Vapor Barrier membrane must have the following properties.
 1. Permeance as tested after mandatory conditioning (ASTM E 154 sections 8,11,12,13) less than 0.01 Perms [grains/(ft² *hr. * in. Hg)]
 2. Other performance criteria
 - a. Strength: ASTM E 1745 Class A
 - b. Thickness: 15 mils minimum

2.2 ACCESSORIES

- A. Seam Tape
 1. Tape must have the following qualities:
 - a. Water Vapor Transmission Rate ASTM E 96, 0.3 perms or lower
 2. Seam Tape
 - a. Manufacturer's standard seam tape.
 - b. Stego Crete Claw (for slabs on void boxes).
- B. Vapor Proofing Mastic
 1. Mastic must have the following qualities:
 - a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
- C. Pipe Boots
 1. Construct pipe boots from Vapor Barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ensure that subsoil is approved by architect or geotechnical firm
 1. Level and tamp or roll aggregate, sand, or tamped earth base.

3.2 INSTALLATION

- A. Install Vapor Barrier:
 1. Installation shall be in accordance with manufacturer's written instructions and ASTM E 1643-09.
 - a. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour.
 - b. Lap Vapor Barrier over footings or seal to foundation walls.
 - c. Overlap joints 6 inches and seal with manufacturer's tape.

- d. Seal all penetrations (including pipes) per manufacturer's instructions.
- e. No penetration of the Vapor Barrier is allowed except for reinforcing steel and permanent utilities.
- f. Repair damaged areas by cutting patches of Vapor Barrier, overlapping damaged area 6 inches, and taping all four sides with tape.

END OF SECTION 03 05 80

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete formwork, for the following:
 - 1. Footings and/or piers.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 33 00 "Architectural Concrete".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 20 00 "Concrete Reinforcing".
 - 5. Section 03 47 13 "Tilt Up Concrete".
 - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 - 7. Section 03 53 00 "Concrete Topping".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. American Concrete Institute (ACI):
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 318 – Building Code Requirements for Structural Concrete
 - d. ACI 347 – Guide to Formwork for Concrete
 - e. ACI SP-4 – Formwork for Concrete.

1.4 PERFORMANCE REQUIREMENTS

- A. Design and engineering of formwork, including shores, reshores, false work, bracing, and other temporary supports as well as determining when temporary supports and bracing can safely be removed after the specified curing time is the Contractor's responsibility.
- B. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

- C. If any post tensioned members exist on the project, the formwork supporting those elements shall:
 - 1. It is essential to take into account the stressing sequence of post-tensioned concrete in the design of the formwork. Any concrete element which is stressed can transfer its weight off the form work to the supporting concrete element in which case the forms for the supporting concrete element must be designed to support the entire load tributary of that element.
 - 2. Forms shall be designed and constructed to permit movement during stressing, both lifting and shortening of the concrete elements.
 - 3. Formwork supporting beams and girders shall be designed to support the weight of the beam or girder's entire tributary area.
 - 4. Formwork supporting post tensioned concrete elements shall not be removed until all concrete supported by the formwork has been fully stressed, but in no case shall the curing time before form removal be less than specified herein.
 - 5. Design, engineering, and production of shop drawings for the form work shall be performed under the supervision of a professional engineer.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Shop drawings for layout of pan type forms, if they exist on the project. Layout only - information and details about the support of these forms is not required, as it is the responsibility of the Contractor and his registered engineer
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- C. Manufacturer's product data and installation instruction for propriety materials used in exposed concrete work including form liners, release agents, form systems, ties, and accessories.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- B. Testing Agency Qualifications: Refer to Section 01 45 23.
- C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Permanent Metal Forms for Slabs: Deck material, gauge and rib pattern shall be as noted on Drawings.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
 - 1. Pans shall be free of dents, irregularities, sag, rust or other deterioration.
 - 2. In areas permanently exposed to view, provide one piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.
- F. Load-bearing Rigid Board Insulating Fill Under Slabs:
 - 1. Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type X, 15 psi minimum compressive strength, 1.30 lb./cu. ft. (21 kg/cu. m) .

- a. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.
 - b. Thermal Resistance: (180-day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
 - c. Blowing Agent Formulation: Zero ozone depleting.
 - d. Install according to manufacturer's recommended instructions.
 2. Expanded Polystyrene Board Insulation: Un-faced Flat Board Stock: Rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578 Type VIII, 15 psi minimum compressive strength .
 - a. Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: [request info \(info@insulfoam.com\)](mailto:request%20info%28info%40insulfoam.com%29); Web: www.insulfoam.com
 - b. Blowing Agent Formulation: Zero ozone depleting.
 - c. Install according to manufacturer's recommended instructions.
- G. Formwork Accessories
 1. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
 2. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
 3. Expansion-Contraction Joint Filler Material: Bonded fabric of thickness indicated on Drawings composed of cellular fibers securely bonded together and uniformly saturated with asphalt complying with ASTM D 1751.
 4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 5. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - c. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class B, 1/4 inch
 3. Class C, 1/2 inch
 4. Class D, 1 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts that are attached to the formwork.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

4. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 3. Determine compressive strength of in place concrete by testing representative field-cured test specimens according to ACI 301.
- B. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
- C. In the absence of cylinder tests, formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period.
- D. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span. Two-way conventionally reinforced slabs shall then be reshored until they attain the specified 28 day strength.
- E. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems that allow form removal without displacing shores. However, the Contractor must demonstrate, to the satisfaction of the Architect, that the early removal of forms will not result in excessive sag, distortion or damage to the concrete elements.
- F. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- G. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

- B. The Contractor shall be solely responsible for proper shoring and reshoring. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- C. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. Reshores shall be located in the same position on each floor. No construction loads shall be placed on the new construction until all supporting reshores have been installed.
 - 1. Extend shores or reshores from ground to top level in structure three stories or less in height, unless noted otherwise.
 - 2. In structures over three stories in height, extend shores or reshores at least three levels under the level being placed. Extend shores beyond the minimum number of levels if required to ensure proper distribution of loads throughout the structure.
 - 3. In crawl spaces or basement, shores or reshores shall extend to mud pads seated firmly on the soil or to on grade construction.
- D. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- E. Bottom tier of reshores shall remain in place until the supported concrete has attained at least 85 percent of the specified 28-day compressive strength and construction loads in excess of 20 psf have been removed but not less than 14 days.

3.5 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be used in the Work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent.
- B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Otherwise, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are to be installed.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform

color and texture. Do not apply cement grout other than that created by the rubbing process.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces indicated or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated or to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment

END OF SECTION 03 10 00

SECTION 03 10 01 – SPREAD FOOTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract, Division 1 - General Requirements, and Drawings apply to Work of this Section.

1.02 RELATED WORK

- A. Section 01410: Quality Control
- B. Section 03300: Concrete

1.03 UNIT PRICE

- A. Elevations given are for bidding/estimating purposes only. Should field conditions require footings to be deeper or shallower, adjustment in Contract shall be made on a unit price basis.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Retarding Admixture: ASTM C494, Type B.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Establish bottoms of footings in stratum as indicated on Drawings. Elevations given are for bidding/estimating purposes only.
- B. Totally excavate soils encountered to size, depths, and elevations indicated on Drawings as necessary for construction of Work, including space for forms, bracing and shoring, waterproofing, and inspection.
- C. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods, as required to prevent cave-ins or loose dirt from falling into excavations.
- D. Grade around excavation to prevent surface water runoff into excavated area.
- E. Excavate bottom of footing level with 1/24 maximum slope.
- F. Protect bottom of excavations and soil around and beneath foundations from frost. Do not place concrete on frozen soil.
- G. Notify Architect of unexpected subsurface conditions and discontinue Work in area until Architect provides notification to resume Work.

H. Drilling of spread footings:

1. As indicated on Drawings, drill footings in true alignment at locations as indicated on Drawings with maximum lateral variation not exceeding lesser of 3 inches or 4% of diameter.
2. Drill footing plumb. Deviation more than lesser of 10% of diameter or 1% of full height, from vertical, will be cause for rejection.
3. Drill footing using rotary rigs through overburden into bearing material as indicated on Drawings. Take top of bearing material at elevation as indicated on Drawings. Elevation is set for estimating purposes only and is not to be construed as elevation of top of bearing material throughout site. Actual elevation shall be verified by Geotechnical Consultant in field.

3.02 BEARING STRATA

- A. On-site inspection of foundation bearing strata shall be conducted during construction by Geotechnical Consultant.
- B. Soft areas of bearing strata or areas otherwise disturbed shall be repaired in accordance with recommendations of Geotechnical Consultant.

3.03 WATER REMOVAL

- A. Prior to concrete placement, remove all water from bottom of excavation.

3.04 PLACING OF FOOTING REINFORCEMENT

- A. Clean reinforcement of foreign materials which will destroy or reduce bond with concrete.
- B. Install reinforcement indicated on Drawings as follows:
 1. Support cage off bottom of excavation distance indicated on Drawings.
 2. Firmly secure cage in place, free of contact with sides of excavation, distance indicated on Drawings.
- C. Provide dowels or anchor bolts in footings as indicated on Drawings.

3.05 CONCRETE PLACEMENT

- A. Place concrete immediately after excavation has been inspected and bearing strata found acceptable by Geotechnical Engineer.
- B. Place concrete in footing by free fall, hopper, or tremie, as needed to prevent segregation or striking side of excavation or reinforcement.
- C. Place concrete continuously without construction joints for full depth of footing.
- D. Vibrate concrete for full depth of footing.
- E. During placement of concrete, and until concrete has set, provide protection around top of excavation to prevent entry of soil or other foreign matter.

- F. Placement should be controlled by qualified personnel through continuous observation.

3.06 FIELD QUALITY CONTROL

- A. Geotechnical Consultant shall provide qualified personnel at site to inspect footings as follows:
1. Before reinforcement and concrete is placed, inspect each footing as follows:
 - a. Inspect excavations to ensure seating in bearing strata which produces foundation capacities indicated on Drawings.
 - b. Inspect excavations to ensure that they are properly cleaned and dried.
 - c. Inspect dimensions of footing for conformance to Drawings, both size and location. Contractor is responsible for providing to Geotechnical Consultant, site elevations and top of footing center alignment survey.
 2. Inspect reinforcement as follows:
 - a. Prior to placement, inspect reinforcement for grade, quality of material, absence of foreign matter, and for suitable storage.
 - b. Provide continuous inspection of reinforcement during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, clearances, form tolerance, security of support and ties, and absence of foreign matter on reinforcement.
- B. Geotechnical Consultant shall submit inspection reports to Architect for each footing. Report shall include:
1. Elevation of top of bearing strata.
 2. Size of footing (or diameter and thickness).
 3. Statement describing whether or not footing reinforcement and reinforcement placement conformed to Drawings.
 4. Statement evaluating that footing seated in indicated bearing strata will produce foundation capacities indicated on Drawings.

END OF SECTION 02 03 80

SECTION 03 15 13 - WATERSTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.
- B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.
- C. Non-metallic waterstops for use in concrete joints subjected to acids, bases, alcohols, oils, solvents, or other chemicals.

1.3 REFERENCES

- A. PVC WATERSTOP
 - 1. Corps of Engineers: CRD-C 572-74
 - 2. American Society for Testing Materials (ASTM)
 - 3. Bureau of Reclamation: C-902
 - 4. Canadian General Standards Board: 41-GP-35M Types 1 & 3
 - 5. ACI 350.2: Concrete Structures for Containment of Hazardous Materials
- B. HYDROPHILIC WATERSTOP
 - 1. American Society for Testing Materials (ASTM)

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

1.5 SUBMITTALS

- A. Submit shop drawings and fabrication drawings indicating placement of waterstops and shop fabrications.
- B. Submit manufacturer's test data for chemical resistance.

PART 2 - PRODUCTS

2.1 PVC WATERSTOPS FOR EXPANSION JOINTS

- A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak or approved equal.

- B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.
- C. Profile: Ribbed with center bulb.
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F
Stiffness in Flexure	ASTM D 747	600 psi min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalis after 7 days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% +/- 5 points

2.2 CHEMICALLY RESISTANT FLEXIBLE WATERSTOP

- A. Thermoplastic elastomeric rubber waterstops resistant to oil, solvents, and chemicals as manufactured by Westec or approved equal.
- B. Chemical resistance testing to be performed by independent ASTM certified laboratory.
- C. Profile: Ribbed with center bulb
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance requirements as follows:

Property	Test Method	Unexposed Value
Tensile Strength	ASTM D638	2000 psi
Ultimate Elongation	ASTM D638	450%
100% Modulus	ASTM D638	1000 psi
Shore A Hardness	ASTM D2240	85 units
Low Temp Brittleness	ASTM D746	No Failure @ -70 F

- F. Waterstop material should show less than +/- 30% change in material properties, including weight gain after 7-day exposure to selected chemicals, per ASTM D 471 testing.

2.3 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS

- A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number (fill in profile style number).
- B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
- C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- D. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

Modified Chloroprene (Hydrophilic) Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70o F	3 to 1 min.

2.4 ACCESSORIES

- A. PVC and Chemically Resistant Waterstops
1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
 2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
 3. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.
 4. Splices to be free from defects.
- B. Hydrophilic Waterstops
1. Provide Greenstreak 7300 two component epoxy gel to secure HYDROTITE to rough, wet (or dry) concrete.

2. Provide LEAKMASTER single component hydrophilic sealant to secure HYDROTITE to rough, dry concrete.
3. Provide cyanoacrylate adhesive (super glue) for all splices.
4. Provide LEAKMASTER as addition to cyanoacrylate adhesive at all splices for added insurance (Optional).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PVC and Chemically Resistant Waterstops
 1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
 2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
 3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12" on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.
 4. Install in longest lengths practicable.
 5. Ensure steel reinforcing bars do not interfere with proper position of waterstop.
 6. Clean concrete joints of dirt and construction debris prior to second pour of concrete.
 7. Cut waterstop ends with miter guide and circular saw to ensure good, full contact at joints.
 8. At expansion joints, keep center bulb unembedded at joint centerline.
- B. Hydrophilic Waterstop
 1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
 2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER (LEAKMASTER is optional).
 3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
 4. Follow approved manufacturer written recommendations.
 5. Install in longest length practicable.
- C. Hydrophilic and PVC Intersections
 1. Maintain continuity of waterstops at all intersections and transitions.
 2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
 3. Follow approved manufacturer written recommendations.
- D. Retrofit Waterstop
 1. Prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond.
 2. Apply continuous bed of epoxy to concrete 1/8 inch thick.
 3. Embed retrofit waterstop in uncured epoxy.
 4. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6 inches OC max. Use batten bars on top and bottom.
 5. Tool continuous layer of epoxy over batten bars and bolts to protect from corrosion.
 6. Use expansion joint filler at moving joints to minimize shear stresses.

- E. Concrete Placement at Waterstop
 - 1. Carefully place concrete without displacing waterstop from proper position.
 - 2. Thoroughly and systematically vibrate concrete around waterstop to obtain impervious, void free concrete in vicinity of joint and to maximize intimate contact between concrete and waterstop.
 - 3. After first pour, clean un-embedded waterstop leg to ensure full contact of second pour concrete.

END OF SECTION 03 15 13

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete reinforcement, for the following:
 - 1. Footings and/or piers.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 10 00 "Concrete Forming and Accessories".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 47 13 "Tilt Up Concrete".
 - 5. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 - 6. Section 04 22 00 "Concrete Unit Masonry".
 - 7. Section 31 20 00 "Earth Moving".
 - 8. Section 31 63 29 "Drilled Concrete Piers".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. American Concrete Institute (ACI)
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 315 – Details and Detailing of Concrete Reinforcement
 - d. SP-66 ACI Detailing Manual
 - 2. American Welding Society (AWS)
 - a. AWS D1.1 – Structural Welding Code
 - 3. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI – Manual of Standard Practice
 - b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
 - c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
 - 4. American Society of Testing Materials (ASTM)

- a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
 - b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
 - c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
 - e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.
- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 "Details and Detailing of Concrete Reinforcement."
 - 1. Do not reproduce the structural drawings for use as shop drawings.
- C. Bar Supports: Submit manufacturer's product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Steel reinforcement and accessories.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 75 as indicated on Drawings, deformed.
- C. Low-Alloy-Steel Reinforcing Bars for bars to be welded: ASTM A 706, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.
- D. Add the following paragraph below for stainless-steel reinforcement. Retain one of two options for reinforcement type.
- E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.
- F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- G. Plain-Steel Wire: ASTM A 82, as drawn.
- H. Deformed-Steel Wire: ASTM A 496.
- I. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:
 - 1. Sheared length: Plus or minus 1 inch.
 - 2. Depth of truss bars: Plus 0, minus ½ inch.
 - 3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
 - 4. Other bends: Plus or minus 1 inch.
- B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

2.4 DOWEL BAR ANCHORS/SPLICERS

- A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable.
 - 1. Richmond Screw Anchor "Dowel Bar Splicer"
 - 2. Erico "Lenton Form Saver"
 - 3. Dayton Barsplice "Grip-Twist"

2.5 MECHANICAL SPLICES

- A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O test reports. The following bar splicing systems are acceptable.
 - 1. Erico "Cadweld C-Series"
 - 2. Erico "Lenton"
 - 3. Dayton Barsplice "Bar Grip"

4. Dayton Barsplice "Grip Twist"

2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES

- A. Steel Shapes and Plates: Conform to ASTM A36, "Specification for Structural Steel".
- B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- C. Welding Electrodes: AWS 5.5, Series E70.
- D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- E. All metal assemblies exposed to earth, weather, or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES

- A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and AWS D1.1. Welding shall be done by AWS certified welders.
- B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.
- C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.
- D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.
- G. Place bars to following tolerances:
 1. Clear distance to formed surfaces: Plus or minus 1/4 inch.
 2. Minimum spacing between bars: Minus 1/4 inch.
 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: Plus or minus 1/4 inch.
 - b. Members between 8 and 24 inches deep: Plus or minus 1/2 inch.
 - c. Members more than 24 inches deep: Plus or minus 1 inch.
 4. Crosswise of members: Spaced evenly within 2 inches.
 5. Length of members: Plus or minus 2 inches.
- H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.
- I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.

- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Structural Testing and Inspection Services".
 - 2. Section 03 20 00 "Concrete Forming and Accessories".
 - 3. Section 03 10 00 "Concrete Reinforcing".
 - 4. Section 03 11 31 "Void Forms".
 - 5. Section 03 15 13 "Waterstops".
 - 6. Section 03 05 80 "Under-slab Vapor Barrier – Retarder".
 - 7. Section 03 47 13 "Tilt Up Concrete".
 - 8. Section 31 63 29 "Drilled Concrete Piers and Shafts".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. ACI 301 – Specification for Structural Concrete.
 - 2. ACI 302 – Guide for Concrete Floor Slab Construction.
 - 3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 4. ACI 305 – Hot Weather Concreting.
 - 5. ACI 306 – Cold Weather Concreting.
 - 6. ACI 308 – Guide to Curing Concrete.
 - 7. ACI 309 – Guide for Consolidating Concrete.
 - 8. ACI 311 – ACI Manual for Concrete Inspection.
 - 9. ACI 318 – Building Code Requirements for Reinforced Concrete.
 - 10. ACI 347 – Guide to Concrete Formwork.
 - 11. ACI 207 – Mass Concrete.
 - 12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
14. ACI 212.3 – Chemical Admixture for Concrete.
15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
16. ACI 214 – Evaluation of Strength Test Results of Concrete.
17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
18. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.

- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
 2. Proportions of cement, fine, and coarse aggregate, and water.
 3. Design strength.
 4. Maximum slump.
 5. Air Content.
 6. Maximum water / cement ratio.
 7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
 8. Type cement and aggregates.
 9. Type and quantities of all admixtures.
 10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
 11. Type, color, and quantities of integral coloring compounds, where applicable.
 12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.
- D. Formwork Shop Drawings: Refer Section 03 10 00.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Semi rigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: See Section 01 45 23.
 - 1. Contractor's responsibility to testing laboratory.
 - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
 - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
 - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. See Section 03 10 00.

2.2 STEEL REINFORCEMENT

- A. See Section 03 20 00.

2.3 REINFORCEMENT ACCESSORIES

- A. See Section 03 20 00.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride (except the chemical admixture Xypex).
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
 - 7. Waterproofing Admixture: Xypex Admix C-500
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.
 - f. QC Construction Products.
 - g. Rockwood Pigments NA, Inc.
 - h. Scofield, L. M. Company.

- i. Solomon Colors, Inc.
- 2. Color: As selected by Architect from manufacturer's full range.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3M; Scotchcast Polyolefin Fibers 2".
 - b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - c. FORTA Corporation; FORTA FERRO.
 - d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
 - e. Nycon, Inc.; XL.
 - f. Propex Concrete Systems Corp.; Fibermesh 650.
 - g. Sika Corporation; Sika Fiber MS or MS10.

2.7 CONCRETE MIX DESIGNS

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'_c by the amount defined in ACI 301.

2.8 VAPOR RETARDERS

- A. See Section 03 05 80.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Alox.

- b. L&M Construction Chemicals, Inc.; Grip It AO.
- c. Master Builders Solutions; MasterTop 120SR (Pre-2014: Frictex NS)

2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - h. Kaufman Products, Inc.; SureHard.
 - i. L&M Construction Chemicals, Inc.; Seal Hard.
 - j. Meadows, W. R., Inc.; LIQUI-HARD.
 - k. Metalcrete Industries; Floorsaver.
 - l. Nox-Crete Products Group; Duro-Nox.
 - m. Symons by Dayton Superior; Buff Hard.
 - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
 - o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATExOL CimFilm.
 - b. ChemMasters; SprayFilm.
 - c. Conspec by Dayton Superior; Aquafilm.
 - d. Dayton Superior Corporation; Sure Film (J-74).
 - e. Edoco by Dayton Superior; BurkeFilm.
 - f. Euclid Chemical Company (The), an RPM company; Eucobar.
 - g. Kaufman Products, Inc.; Vapor-Aid.

- h. Lambert Corporation; LAMBCO Skin.
 - i. L&M Construction Chemicals, Inc.; E-CON.
 - j. Master Builders Solutions; MasterKure ER 50 (Pre-2014: Conflim).
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; W.B. Resin Cure.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior; Res X Cure WB.
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; AQUA KURE - CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M Cure R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR.
 - k. Nox-Crete Products Group; Resin Cure E.
 - l. Right Pointe; Clear Water Resin.
 - m. SpecChem, LLC; Spec Rez Clear.
 - n. Symons by Dayton Superior; Resi-Chem Clear.
 - o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Polyseal WB.
 - b. Conspec by Dayton Superior; Sealcure 1315 WB.
 - c. Edoco by Dayton Superior; Cureseal 1315 WB.
 - d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.

- e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - f. Lambert Corporation; UV Safe Seal.
 - g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - h. Master Builders Solutions; MasterKure CC 1315WB (Pre 2014: Kure1315).
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.
 - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 NON-SHRINK GROUT

- A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:
 - 1. "Euco NS" by Euclid Chemical Company
 - 2. "Masterflow 713" by Master Builders.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

2.17 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. See Section 03 10 00.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. See Section 03 10 00.

3.4 SHORES AND RESHORES

- A. See Section 03 10 00.

3.5 VAPOR RETARDERS/BARRIERS

- A. See Section 03 05 80.

3.6 STEEL REINFORCEMENT

- A. See Section 03 20 00

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. See Section 03 10 00.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated and/or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and/or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces according to ASTM E 1155, for a randomly trafficked floor surface.

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

3.11 CONCRETE FLOOR FINISH TOLERANCES

- A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
 - 1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, FI =25; with minimum local values of flatness, Ff =24; and levelness, FI =17.
 - 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, FI = 20; with minimum local values of flatness, Ff =17; and levelness, FI =15.
- B. Floor Elevation Tolerance Envelope:
 - 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - a. Slab-on-Grade, or Slab-on-Void Construction: +/- 3/4"
 - b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
 - c. Top surfaces of all other slabs: +/- 3/4"
 - d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-

place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
- 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 28 days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 - 1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 - 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 - 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 - 4. Control and dispose of waste products produced by grinding and polishing operations.
 - 5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's

written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
- NOTE: Add articles for flowable fill in products and execution. NEEDS RESEARCH.

END OF SECTION 03 30 00

SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Concrete masonry units (CMU).

1.3 DEFINITIONS

- A. CMU: Concrete masonry unit.
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
- C. Underwriters' Laboratories, Inc. (UL).

1.4 RELATED WORK

- A. Section 01 45 23 - Testing and Inspecting Services.
- B. Section 05 50 00 – Metal Fabrications. Steel masonry lintels.
- C. Section 07 11 00 – Bituminous Dampproofing.
- D. Section 07 21 00 – Thermal Insulation.
- E. Section 07 92 00 – Joint Sealants.
- F. Section 09 90 00 – Painting and Coatings.
- G. All Sections of Work built-in, adjacent to, or applied to unit masonry Work.

1.5 REFERENCES

- A. ASTM International (ASTM)
 - 1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron & Steel Hardware.
 - 2. A307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 3. A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 4. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 5. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
 - 6. C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
 - 7. C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 8. C150, Standard Specification for Portland Cement.
 - 9. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 10. C270 - Standard Specification for Mortar for Unit Masonry.
 - 11. C331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
 - 12. C332 - Standard Specification for Lightweight Aggregates for Insulating Concrete.
 - 13. C404 - Standard Specification for Aggregates for Masonry Grout.
 - 14. C476 - Standard Specification for Grout for Masonry.

15. C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
16. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
17. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
18. D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
19. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
20. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.6 QUALITY ASSURANCE

- A. Where requirements of this Section are in conflict with requirements noted on the Structural Drawings, the Structural Drawings shall take precedence. Refer to Structural Drawings for information on load-bearing CMU walls.
- B. Fire Performance Characteristics: Where indicated or required, provide materials and construction which are identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L. or other recognized testing and inspection organization or by other means, acceptable to authority having jurisdiction.
- C. Masonry Cleaning: Workers shall have minimum 5 years of masonry cleaning experience, and shall be approved by cleaner manufacturer prior to application of cleaning material, and shall meet with cleaner manufacturer for demonstration and instructions for use of product prior to application.
- D. Perimeter Walk-Around: Daily perimeter walk-around the exterior side of the masonry by the GC and or masonry Subcontractor at the end of each Work day as a visual inspection looking for obvious issues or flaws concerning colors, finishes, workmanship, protection of Work.
- E. Source Limitations:
 1. For Masonry Units: Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one (1) manufacturer for each different product required for each continuous surface or visually related surfaces.
 2. For Mortar and Grout Materials: Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work where exposed to view and where not scheduled to receive a subsequently applied finish, i.e. parging, painting, etc., unless directed otherwise in writing by the Architect.
 3. Contractor's Responsibility: Contractor performing Work of this Section shall be responsible for coordinating with others performing Work which is built-in or adjacent to unit masonry Work.

1.7 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Sample Panel(s):
 1. Do not start masonry until Architect has approved samples.
 2. Sample panel shall be 6 feet long by 8 feet high showing selected color range and texture, bonding, joint shape, and quality of workmanship. Include an expansion joint, and any specialty details, such as reveals, soldier courses, etc. Include mock-up of installation of thru-wall flashing at foundation sill and lintel above openings, window jambs and sills.
 3. A separate panel for each type of masonry used is required.
Sample panel(s) shall remain at the jobsite until all masonry is completed.
Installed materials shall be visible and integrated into adjacent materials.

4. Brace and support as required to withstand structural wind loads.

C. Certification: Submit manufacturer's affidavit that materials used in Project contain no asbestos.

D. Mortar and Grout Mix Designs: Submit two (2) copies of proposed mortar and grout mix designs to Owner's testing laboratory.

1.8 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for typical exterior wall in sizes approximately 72 inches (1800 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant filled joint at least 16 inches (400 mm) long in each mockup.
 - b. Include each type of masonry on one face of interior unit masonry wall mockup.
3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
4. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
5. Protect accepted mockups from the elements with weather resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 TESTS AND INSPECTIONS

A. Materials and installation of masonry shall be subject to testing and inspection by an independent testing laboratory. Such tests and inspections shall not relieve Contractor of responsibilities for providing materials and procedures which comply with Contract Documents. Promptly remove and replace materials which do not comply.

B. Owner will select Inspection and Testing Laboratory and will pay for all Work required by Inspection and Testing Laboratory.

1.11 DELIVERY, STORAGE AND PROTECTION

A. Deliver and store materials in dry protected areas off ground. Keep free of stain or other damage before, during and after installation. Replace any damaged material at no cost to Owner.

- B. During freezing weather, protect masonry units with tarpaulins or other suitable material. Keep free of stain or other damage before, during and after installation. Replace damaged material at no cost to Owner.
- C. Protect reinforcement and accessories from elements.

1.12 SITE CONDITIONS

- A. Cold Weather Protection:
 - 1. No masonry shall be laid when the temperature of the outside air is below 40 degrees F, unless protection measures are employed and pre-approved by the Architect.
 - 2. Protection measures for cold weather erection include maintaining space and masonry unit temperatures of at least 40 degrees F for 48 hours prior to and after erection.
- B. Hot Weather Protection:
 - 1. When the mean daily temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three (3) times a day until the masonry is three (3) days old.

1.13 BRACING OF MASONRY DURING ERECTION

- A. All masonry shall be adequately braced at all times during erection.

1.14 COORDINATION

- A. Openings and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry walls as required. Provide for installation of bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as required. Consult other trades in advance and make provisions for installation of their Work to avoid cutting and patching. Coordinate installation of steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.
- B. Contractor performing Work of this Section shall be responsible for and coordinate with Work of Section 07 11 00, Dampproofing Above Grade and all Sections of Work built-in, adjacent to, or applied to unit masonry Work.

1.15 WARRANTY

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of unit or mortar finish.
 - 2. Chalking or dusting excessively.
 - 3. Changing color in irregular fashion.
 - 4. Cracking or spalling.
 - 5. Releasing from substrate.
 - 6. Staining or discoloring, including efflorescence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Specifications are based on products of manufacturers named within the specifications. Other manufacturers must have a minimum of five (5) years experience manufacturing products equal to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
1. Concrete Masonry Units (CMU/Block) Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Best Block Construction Materials formerly known as Headwaters Concrete Products/Boral Concrete Products.
 - b. Texas Building Products, Inc.
 - c. Revels Block & Brick Co., Inc.

2.2 MATERIALS

- A. Concrete Masonry Units (CMU/Block):
1. Type/Sizes:
 - a. Concealed cavity block and interior block, unless otherwise noted: Regular smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 - 1) Color: Architect to select from manufacturers full range or noted on Drawings.
 - b. Exterior exposed block: Regular Smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 - 1) Color: Architect to select from manufacturers full range or noted on Drawings.
 - c. Exterior exposed burnished block: Integrally colored face units with 8 inch by 16 inch face dimensions with half scored partition as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 - 1) Color: Architect to select from manufacturers full range or noted on Drawings.
 - d. Interior block, unless otherwise noted: Regular smooth face units with 8 inch x 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 - 2) Interior exposed burnished block: Integrally colored face units with 8 inch by 16 inch face dimensions with half scored partition as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 - 2) Color: Architect to select from manufacturers full range or noted on Drawings.
 - 3) Interior exposed solid burnished block with half scored partition and double chamfered corners:
 - 1) Color: Architect to select from manufacturers full range or noted on Drawings.
 - 2) Size: As shown on drawings.
 2. Integral Water Repellant (In exterior exposed CMU): "Dry-Block Block Admixture" integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp), or equal.
 3. Specification: Comply with ASTM C90 (Class D-2 (2 hour) and Class B-4 (4 hour)) block at rated walls).
 - a. Aggregate: Lightweight in accordance with ASTM C331.
 4. Curing: Rotary kiln process.
 5. Provide bullnose units at all outside corners.
 6. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and fillers to match and compliment block units as shown or required.

B. Mortar:

1. Materials: (Unless stated otherwise on Structural Drawings)
 - a. Portland Cement: ASTM C150, Type 1.
 - b. Hydrated Lime: ASTM C207, TYPE "N", typical. Use TYPE "S" for load-bearing masonry.
 - c. Aggregate: Sand conforming to ASTM C144.
 - d. Water: Clean and potable.
 - e. Admixtures For Mortar:
 - 1) General: Do not use calcium chloride
 - 2) Concrete Masonry Units: Spectrum Mortar Color or Architect approved equal.
 - 3) Integral Water Repellant (In mortar of exterior exposed CMU): "Dry- Block Mortar Admixture" integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp) or equal. Note: Water repellent block admixture and mortar admixture are not interchangeable.
2. Mix Design: (Proportions by volume) (Unless stated otherwise on Structural Drawings)
 - a. Typical, Non-load bearing masonry
 - 1) Type: ASTM C270, Type "N."
 - 2) Proportions: 1 part cement, 1 part hydrated lime and 6 parts sand to provide a compressive strength of 750 psi in 28 days. Do not use calcium chloride.
 - b. Load bearing structural masonry
 - 1) Type: ASTM C270, Type "S."
 - 2) Proportions: 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide a compressive strength of 1800 psi in 28 days. Do not use calcium chloride.

C. Grout:

1. Materials: (Unless stated otherwise on Structural Drawings)
 - a. Hydrated Lime: ASTM C207, TYPE "S."
 - b. Portland Cement: ASTM C150, Type 1.
 - c. Water: Clean and potable
 - d. Aggregates:
 - 1) Course aggregate shall conform to ASTM C404.
 - 2) Fine aggregate shall conform to ASTM C144.
2. Mix Design: (Unless stated otherwise on Structural Drawings)
 - a. Comply with ASTM C476 to provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.
 - 1) Fine Grout: Fine grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
 - 2) Course Grout Mix: Course grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand, and 1 to 2 parts course aggregate.

D. Reinforcement, Anchors and Tie Systems:

1. General: Reinforcement used in all wythes shall be galvanized after fabrication in accordance with ASTM A153, Class B-2.
2. Approved Manufacturers include the following:
 - a. Heckmann Building Products
 - b. Hohmann & Barnard, Inc
 - c. Wire-Bond
3. At solid multiple wythe masonry walls and single wythe masonry walls, (Interior partitions) use #9 gauge truss type reinforcing. Pre-fab corners and tees shall be used at all wall

corners and intersections; width shall be two (2) inches less than nominal thickness of walls. Hohmann & Barnard "120 Truss-Mesh" at single wythe; "230 Ladder-Tri-Mesh" at multiple, or Architect approved equal.

4. Control Joint Anchor: Equal to Heckmann Building Products, Inc. No. 351 Anchor.
5. Corrugated Wall Tiles: Not acceptable under any circumstances.

E. Block Insulation:

1. Foamed-In Place Block Insulation:
 - a. Type: Two (2) component system consisting of amino-plast resin and a catalyst foaming agent surfactant.
 - b. Features:
 - 1) Designed to completely fill irregular or hard-to-reach spaces.
 - 2) Can be installed in both new and existing concrete masonry unit construction.
 - 3) Excellent energy and sound insulation values.
 - 4) No settling or expansion after installation.
 - 5) Superior fire and safety performance.
 - 6) No CFC's or HFC's.
 - 7) Safe for the environment.
 - 8) Approved Products/Manufacturers: "Core-Fill 500" manufactured by Tailored Chemical Products, Inc., Longview, TX; (800) 256-3626, Polymaster R-501 Foam Insulation manufactured by Polymaster of Houston, (713) 856-6318.or Architect approved equivalent.

F. Precast Concrete U-Lintels (Contractors Option to site built masonry lintels)

1. Concrete Materials:
 - a. Portland Cement: ASTM C150 Type I or III, gray color.
 - b. Aggregates: ASTM C33.
 - c. Water: potable
 - d. Admixtures: Shall not contain calcium chloride or chloride ions
2. Reinforcing:
 - a. Deformed Reinforcement: ASTM A615 Grade 40 or 60.
 - b. Prestressing Strand: ASTM A416 270 ksi LL.
3. Fabrication:
 - a. Unless specified otherwise, conform to PCI MNL-116.
 - b. U-lintel units 14 feet in overall length and shorter shall be made of concrete with a minimum strength of 3500 psi at 28 days.
 - c. U-lintel units exceeding 14 feet in overall length shall be made of concrete with a minimum strength of 6000 psi at 28 days and shall be prestressed concrete.
 - d. Units shall be sand block finish except prestressed, 6 inch wide, and 12 inch wide U-lintels shall be smooth form finished.
 - e. Tolerances shall be per PCI MNL-116
 - f. Minor patching in plant is acceptable provided structural adequacy of units is not impaired
4. Acceptable Product/Manufacturer: Cast-Crete High Strength Precast Concrete U-lintels as manufactured by Cast-Crete, Tampa, FL (800) 999-4641, and locally distributed by Headwaters, (713) 365-9077.

G. Miscellaneous Materials: (As shown or required)

1. Reinforcing Steel: ASTM A615, Grade 60.
2. Forms: Form grade plywood with wood studs and wales as required.

3. Shores: Patented shores of design and manufacture sufficient to safely support imposed loads.
4. Premolded Filler: Fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751.
5. Flashing Cement: "Nerva-plast" cold setting mastic manufactured by Nervastral, Inc., or Architect approved equal.
6. Building Felt: No. 15 asphalt saturated felt, ASTM D226.
7. Dovetail Anchors: 16 gauge galvanized dovetail corrugated masonry anchor, 1 inch x 3-1/2 inch manufactured by Heckman Building Products, Inc., Hohmann & Barnard, Inc., Masonry Reinforcing Corporation of America, or Architect approved equal.
8. Steel Shapes and Plates: As shown on drawings and specified in Section 05 50 00, Metal Fabrications.
9. Headed Stud Anchor: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
10. Bolts: ASTM A307. Furnish with carbon steel washers.
11. Deformed Bar Anchors: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
12. Reinforcing Bars to be Welded: ASTM A706.
13. Cavity Drainage Protection: 2 inch thick by 10 inch high by 5 feet long recycled polyester/polyethylene mesh, trapezoidal-shaped, continuous at foundation, at heads above openings, and shelf angles as indicated on drawings. Provide Mortar Net™ manufactured by Mortar Net Solutions, Burns Harbor, IN; (800) 664-6638, or Architect approved equal.
14. Masonry Color: Iron oxide pigment conforming to ASTM C979 in color(s) selected by Architect, shall be inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, and free of fillers and extenders, as manufactured by ChemSystems, Inc., Davis Colors, Solomon Grind-Chem Service, Inc., or Architect approved equal.
15. Weep Hole Vents: Injection molded vent made from flexible polyvinyl chloride in an offset "T" shape, inserted in head joints, the slotted leg of the vent allows air to pass in and out allows water to weep out and prevents water from penetrating in manufactured by Williams-Goodco, Phone: 800-521-9594 or 248-643-6400 or Email: Wilpro@williamsproducts.net. Weep hole vents shall be sized to match masonry (may require custom sizing).

2.3 MASONRY STRENGTH

- A. Ultimate compressive strength of masonry as required by design and determined by prism tests shall not be less than 1,800 psi, unless stated otherwise in Structural Drawings.

2.4 MASONRY CLEANING MATERIALS

- A. Detergent Cleaner: Bucket and brush hand cleaning method, BIA Technical Notes 20.
- B. Proprietary Acidic Cleaner: Cleaner designed for removing mortar/grout stains, efflorescence, and construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. PROSOCO, Inc.
 - c. AHI Supply.

- C. The following products based on AHI Supply TexClean products are intended as a guide only and does not preclude the contractors use of equal products by listed manufacturers. Consult manufacturer prior to application for any questions or inconsistencies.

Substrate	Color/Type	Cleaning Solution
Brick	Red	Tex Clean Masonry Cleaner
	Light	Tex Tral Masonry Cleaner
	Dark	Tex Tral Masonry Cleaner
	Pavers	Tex Clean Masonry Cleaner
	Glazed	Tex Tral Masonry Cleaner
CMU	Split Face	Tex Tral Masonry Cleaner
	Burnished/Ground Face	Tex Tral Masonry Cleaner
Architectural Concrete	Natural Color/Smooth	Tex Tral Masonry Cleaner
	Textured	Tex Clean Masonry Cleaner
Stone Construction	Cast Stone	Tex Tral Masonry Cleaner
	Arriscraft	Tex Tral Masonry Cleaner
	Limestone (Unpolished)	Tex Tral Masonry Cleaner

PART 3 - EXECUTION

3.1 FORMS AND SHORES

- A. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.
- B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.

3.2 PREPARATION OF MATERIALS

- A. Concrete Masonry Units:
 1. Where cutting is required, masonry shall be cut with a sharp masonry saw.
 2. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.
- B. Mortar and Grout:
 1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable.
 2. Thoroughly machine mix a minimum of five (5) minutes after all materials are in mixer.

3. Consistency will completely fill all spaces intended to receive grout.
4. Use within 2-1/2 hours of initial mixing.
5. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.

C. Reinforcement:

1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond.
2. Cut accurately to length and bend by such methods as will prevent injury to the material.
3. Straighten out kinks or bends.

D. Flashing:

1. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces.
2. Bed Joints: Coordinate Work with Division 4, Masonry. Install flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back from face of masonry.
3. Adjacent Work: Protect Work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
4. Separate copper flashing from dissimilar materials.
5. Protect membrane flashing from overexposure to direct sunlight.

3.3 INSTALLATION

A. General:

1. Do not use chipped or cracked concrete masonry units (CMU), where exposed to view.
2. Use masonry saws to cut and fit exposed units.
3. Exposed masonry at exterior corners shall be solid units.
4. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
5. Place through-wall flashing as follows:
 - a. Place on bed of mortar and cover with mortar.
 - b. Provide at steel columns and beams in exterior masonry walls and elsewhere as indicated on the drawings or required.
 - c. Install asphalt laminated copper membrane as base flashing at all exterior cavity walls below weep holes.
 - d. Install at material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior wall sill/weep conditions, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.
6. Lay masonry units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
7. Do not furrow bed joints.
8. Stop off horizontal run by racking back in each course; toothing is not permitted.
9. Adjust units to final position while mortar is soft and plastic.
10. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh mortar.
11. When joining fresh masonry to set or partially set masonry:
 - a. Remove loose masonry units and mortar
 - b. Clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.

B. Metal Door Frames: Fill jamb frames solid with mortar. Build in anchors.

- C. Lintels and Bond Beams: Provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.
- D. Corners: Connect corners with No. 9 galvanized wire tie using one tie for each 4 inches of nominal wall thickness.
- E. Partition Tops: Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Sealant section. Anchor top of walls to deck or structure.
- F. Mortar Beds:
 - 1. Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
 - 2. Lay units with full mortar coverage on horizontal and vertical joints in all courses.
 - 3. Provide sufficient mortar on ends of masonry unit to fill head joints.
 - 4. Rock closures into place with head joints thrown against two adjacent masonry units in place.
 - 5. Do not pound corners or jambs to fit stretcher units after setting in place.
 - 6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.
- G. Mortar Joints and Patterns:
 - 1. Lay CMU in running one-half (1/2) bond pattern, unless noted otherwise.
 - 2. Provide flush joints where concealed from view and where dampproofing is scheduled.
 - 3. Provide standard concave tooled joint where masonry is exposed to view for CMU, typically.
 - 4. All mortar joints to be of consistent size.
 - 5. Provide soldier courses where indicated, refer to the elevations.
 - 6. All horizontal joints shall be concave tooled joint at face of units, unless noted otherwise.
 - 7. Provide raked joints at all exposed burnished cmu locations.
- H. Reinforcement, Anchor and Tie Systems:
 - 1. General:
 - a. Completely embedded in mortar or grout.
 - b. All reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have no less than 5/8 inch mortar coverage from the exposed face.
 - c. Veneer anchors at exterior sheathed covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws. Spacing shall be same as stud spacing o.c. horizontally and 16 inches o.c. vertically.
 - d. At intersection of all perpendicular masonry walls provide two (2) vertical rows of ladder type reinforcing at 16 inches o.c. vertically.
 - e. Weld veneer anchors to structural steel in accordance with manufacturer's recommendations. Touch-up steel shop paint and galvanized coating on anchor with touch-up primer and finish coats to match damaged coating in accordance with manufacturer's recommendations.
 - f. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.
 - g. Splices in reinforcement: Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall be eight (8) inches. Welded or mechanical connection shall develop the strength of the reinforcement.
 - h. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions are acceptable.

- i. Place joint reinforcement in the first two (2) bed joints above and the first two (2) bed joints below masonry openings. Extend extra reinforcing two (2) feet beyond jambs.
 - j. Provide masonry ties at floor and roof decks as indicated.
- I. Flashing:
 - 1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
 - 2. Application Guidelines - Install flashing at the following locations:
 - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
 - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill/weep conditions, exterior door and window head/weep conditions, masonry wall cap flashing and masonry wall base flashing.
 - 3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
 - 4. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
 - 5. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
 - 6. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
 - 7. Thru-Wall Flashing: Shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
 - 8. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
 - 9. Heads and Sills: Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weepholes.

10. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
 11. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
 12. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
 13. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
 14. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
 15. Reglet Termination: Insert wedge into place and seal carefully with adhesive
 16. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
 17. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.
- J. Laying Masonry: Lay units plumb, level, and true to line with full head and bed joints. Butter ends of masonry with sufficient mortar to fill head joints. Do not furrow bed joints. Slope top of bed joint toward center of wall to minimize amount of mortar forced into grout space. Remove mortar, protruding from joints into grout space, before pouring grout.
- K. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding eight (8) feet-0 inches with a minimum clearance of 1/4 inch from masonry and not less than one (1) bar diameter between bars.
 2. When a foundation dowel is not in alignment with a vertical block cell or pilaster, slope it not more than one (1) horizontal in six (6) vertical to bring it into proper alignment before grouting.
 3. Place horizontal reinforcing bars in continuous masonry courses, consisting of bond-beam or trough block units, and solidly grout in place.
 4. Use straight reinforcing bars except for bends around corners and where bends or hooks are detailed on plans.
 5. Lap reinforcing steel 40 bar diameters minimum where spliced and wire together.
- L. Grouting: Where detailed place grout in reinforced masonry beams, walls, columns, and pilasters. All cells and spaces containing reinforcing bars shall be filled with grout. Wherever possible grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.
1. Prior to grouting clean space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material. Grout shall be placed so all spaces designated to be grouted shall be filled with grout and grout shall be confined to those specific spaces.
 2. Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation of constituents and shall be mixed thoroughly.
 3. Between grout pours a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with grout stopping a minimum of 1-1/2 inches below a mortar joint, except at top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below top of masonry.
 4. Reinforcement shall be placed prior to grouting. Bolts shall be accurately set with templates or by approved equivalent means and held in place to prevent movement.

5. Segregation of grout materials and damage to masonry shall be avoided during the grouting process. Adequately brace masonry to prevent displacement or cracking during grouting operations.
6. Grout shall be consolidated by mechanical vibrator during placing, before loss of plasticity, in a manner to fill grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated, or puddled.
7. Grout shall not be handled nor pumped utilizing aluminum equipment.
8. Size and height limitations of grout space or cell shall be as follows:

GROUT TYPE	GROUT POUR MAX. HEIGHT (FEET)	LEAST CLEAR DIMENSIONS		CLEANOUTS REQUIRED
		Width of Grout Space (In.)	CMU Cell Dim. Dims. (In. x In.)	
Fine	1	3/4	1-1/2 x 2	No
Fine	5	1-1/2	1-1/2 x 2	No
Fine	8	1-1/2	1-1/2 x 3	Yes
Coarse	1	1-1/2	1-1/2 x 3	No
Coarse	5	2	2-1/2 x 3	No
Coarse	8	2	3 x 3	Yes

- a. Clear dimension is the cell or grout space width less mortar projections.
 - b. Grout space width shall be increased by the horizontal projection of the diameters of horizontal bars within the cross section of the grout space.
9. Place grout in lifts not exceeding 8 feet-0 inches.
- M. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report discrepancies or procedures which may adversely affect performance of masonry Work.
- N. Sealant Joints:
1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings.
 2. Uniform depth: 3/4 inch.
 3. Uniform width: As shown on the drawings but not less than 1/4 inch.
 4. Provide sample for Architect's approval.
 5. Refers to drawing for locations and details of accent joints.
- O. Movement Joints (Expansion Joints and Control Joints):
1. Locate expansion and control joints as shown on drawings, or if not shown, comply with the following:
 - a. General:
 - 1) Vertical expansion joints shall be placed in the wythe and control joints shall be placed in the concrete masonry wythe, although they do not necessarily have to be aligned.
 - 2) Mortar and joint reinforcement shall not bridge movement joints.
 - 3) Mortar joints which stop at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.
 - b. Vertical Expansion Joints:

- 1) Locate expansion joints on long straight walls without openings maximum 25 feet-0 inches.
 - 2) Locate expansion joints at the corner of walls perpendicular to one another. In instances, where the joint is not desired at the corner, the expansion joint shall be located within 10 feet-0 inches of the corner in either wall, but not necessarily both. The spacing of expansion joints around a corner shall not exceed the spacing of expansion joints in a straight wall. For example, if the spacing between expansion joints on a straight wall is 25 feet-0 inches, then the spacing of expansion joints around a corner could be 10 feet-0 inches on one side of the corner and 15 feet-0 inches on the other side. Joint reinforcement may be added around wall corners to provide added tensile strength to the corner, but joint reinforcement shall not bridge the expansion joint.
- c. Offsets and Setbacks:
- 1) Locate expansion joints at 10 feet-0 inches maximum on one side of the offset or setback. The spacing of expansion joints around an offset or setback shall not exceed the spacing of expansion joints in a straight wall. See expansion joints at corners of perpendicular walls to one another above for example of spacing.
- d. Openings (Doors and Windows):
- 1) Locate vertical expansion joints along the edge or jamb of the opening of windows and doors. Single opening windows and doors under 6 feet-0 inches in width shall have expansion joint on one (1) side of the edge or jamb of the opening as determined by the Architect, unless shown otherwise on drawings. Windows and doors 6 feet-0 inches and over in width shall have expansion joints on both sides of the edge or jamb of the opening.
 - 2) Where masonry above an opening is supported by shelf angles attached to the structure, a vertical expansion joint shall be located alongside the opening, continuing through the horizontal support.
 - 3) Where masonry above the opening is supported by loose lintels (unattached to the structure), special detailing and construction is required. If the expansion joint runs along side the opening, the loose steel lintel shall be allowed to expand independently of the masonry. To accomplish this, form a slip plane with flashing located above and below the angle. A backer rod and sealant shall be installed in front of the toe of the angle, and space shall be left at the end of the angle. Thus, a pocket will be formed which will allow movement of the steel angle within the masonry. If the joint cannot be built in this manner, then the vertical expansion joint shall not be located alongside the opening, but rather, with Architect's prior approval, the joint shall be located halfway between the openings.
- e. Intersections and Junctions:
- 1) Locate expansion joints at intersections of masonry walls and walls which serve different functions. If the masonry is not required to be bonded at the intersection, an expansion joint shall be incorporated. Walls which intersect at other than right angles are also vulnerable to cracking at the intersection.
 - 2) Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.
- f. Parapets:

- 1) All vertical expansion joints shall be carried through the parapets.
- 2) Additional expansion joints shall be halfway between those running full height, unless the parapet is reinforced. These additional expansion joints shall continue down to a horizontal expansion joint, or continue to the base of the wall.
- g. Horizontal Expansion Joints:
 - 1) Locate horizontal expansion joints at shelf angles supporting masonry.
- h. Control Joints:
 - 1) Locate CMU control joints directly over concrete slab control joints.
 - 2) Whenever possible, lay out CMU so that control joint will coincide with CMU module (25 feet-0 inch maximum spacing between control joints), unless noted otherwise on drawings.
 - 3) Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns.
 - 4) Install backer rod and sealant in accordance with manufacturer's instructions.

3.4 ALLOWABLE TOLERANCES

- A. Maximum Variation from Plumb:
1. In lines and surfaces of columns, walls and at rises:
 - a. 1/4 inch in 10 feet (1:480).
 - b. 3/8 inch in 20 feet (maximum).
 - c. 1/2 inch in 40 feet (1:960).
 2. For external corners, expansion joints and other conspicuous lines:
 - a. 1/4 inch in 20 feet (maximum).
 - b. 1/2 inch in 40 feet (1:960).
- B. Maximum variation from level:
1. 1/4 inch in any bay or 20 feet.
 2. 1/2 inch in 40 feet (1:960).

3.5 REMOVAL OF FORMS AND SHORES

- A. Do not remove shores and forms under reinforced masonry beams, lintels, and soffits until members have hardened sufficiently to carry their own weight and other super imposed loads. Providing that sufficient curing has taken place, leave forms and shores in place as follows:
1. Beam and lintels: Minimum ten (10) days.
- B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads on them. Allow an additional 48 hours before applying concentrated loads such as trusses, girders, and beams.

3.6 REPAIRING, POINTING AND CLEANING

- A. All holes in exposed masonry shall be pointed, and defective joints shall be cut out and re-pointed with mortar.
- B. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet, in a location approved by Architect. No further cleaning Work may proceed until the sample area has been approved by Architect, after which, the same cleaning materials and method shall be used on remaining wall area. Sash, metal lintels and other corrodible parts shall be thoroughly protected.

Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.

1. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
2. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
3. Mix materials in strict accordance with manufacturers instructions; do not dilute unless permitted by manufacturer.
4. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
5. No high pressure washers are permitted.
6. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
7. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

3.7 REPAIR OR REPLACEMENT OF DAMAGED WORK

- A. Imperfect or damaged Work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at Contractor's expense and in conformity with all requirements of drawings and specifications. Removal and replacement of masonry Work shall be performed in such a manner as not to impair the appearance or strength of the structure in any way.

3.8 CLEAN-UP AND PROTECTION

- A. Clean up all debris caused by Work of this Section, keeping the area clean and neat at all times.
- B. Cover all unfinished Work at night against the elements with plastic sheeting, building paper, heavy canvas or other material approved by Architect to prevent water from entering cavities.
- C. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.9 FIELD QUALITY CONTROL AND TESTING

- A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

END OF SECTION 04 22 00

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 - 1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 - 2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 - 1. Decorative CMUs, in the form of small-scale units.
 - 2. Pre-faced CMUs.
 - 3. Colored mortar.
 - 4. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
 - 1. CMUs.
 - 2. Accessories embedded in masonry.

1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 1. Build sample panels for each type of unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
 2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
 3. Protect approved sample panels from the elements with weather-resistant membrane.
 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,000 psi.
 - 2. Density Classification: Normal weight unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
 - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
- F. Mortar Cement: ASTM C 1329.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- H. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints, less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
- J. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
- L. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
 - 1. Interior Walls: Mill- galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter or as indicated on Drawings.
 - 4. Wire Size for Cross Rods: 0.148-inch diameter or as indicated on Drawings.
 - 5. Wire Size for Veneer Ties: 0.148-inch diameter or as indicated on Drawings.

6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units].
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, with ASTM A 153, Class B coating.
 3. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel.
 3. Corrugated Metal Ties: Metal strips not less than 7/8-inch-wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.075-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.
- D. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4-inch-thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153] [Epoxy coating 0.020 inch thick.

2.7 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.

- B. Post-installed Anchors: Torque-controlled expansion anchors or chemical/adhesive anchors unless otherwise indicated on Drawings.
 - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.

2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as indicated on Drawings. Include accessories, adhesives, primers, and seam tapes as applicable.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. For reinforced masonry, use Portland cement-lime mortar.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, Table 1 or] paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi except where indicated on Drawings.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch or minus 1/4-inch.
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch.
 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
 3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
 5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10 feet, 3/8-inch in 20 feet, or 1/2-inch maximum.
 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
- C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch.
 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus 1/4-inch.
 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, unless otherwise indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches or less on center unless otherwise indicated.
 - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.

- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 - 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Prefabricated building columns.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
 - 3. Section 05 31 00 "Steel Decking".
 - 4. Section 13 34 19 "Metal Building Systems".

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.
 - 3. AISC "Specification for Architecturally Exposed Structural Steel".
 - 4. AISC's "Seismic Provisions for Structural Steel Buildings".
 - 5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".

6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: System as indicated on Drawings.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
 8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
1. Qualification Data: For qualified installer, fabricator, and testing agency.
 2. Welding certificates.
 3. Mill test reports for structural steel, including chemical and physical properties.

4. Product Test Reports: For the following:
 - a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - b. Direct-tension indicators.
 - c. Tension-control, high-strength bolt-nut-washer assemblies.
 - d. Shear stud connectors.
 - e. Shop primers.
5. Source quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
 1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 60 percent.
 - 2. Channels, Angles, M, S-Shapes: 60 percent.
 - 3. Plate and Bar: 25 percent.
 - 4. Cold-Formed Hollow Structural Sections: 25 percent.
 - 5. Steel Pipe: 25 percent.
 - 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: Refer Structural General Notes.
- C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.
- D. Plate and Bar: Refer Structural General Notes.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.
- F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.
- G. Steel Pipe: Refer Structural General Notes.
 - 1. Weight Class: See Plans.
 - 2. Finish: Black except where indicated to be galvanized.
- H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain or Mechanically deposited zinc coating, where required.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
 1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 3. Plate Washers: ASTM A 36 carbon steel.
 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 5. Finish:
 - a. General Condition – Plain
 - b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amscot Structural Products Corp.
 - b. Fluorocarbon Company Limited.
 - c. R.J. Watson Bridge & Structural Engineered Systems.
 - d. Seismic Energy Products, L.P.
 2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
 3. Coefficient of Friction: Not more than 0.05.
 4. Design Load: Not less than 5,000 psi .
 5. Total Movement Capability: 2 inches.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.
- D. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

- A. Refer Section 03 30 00.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
 - 1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 - 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
 - 3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
 - 4. Camber tolerance
 - a. Beams 50 feet and less; plus or minus 1/2 inch.
 - b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
 - c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
 - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.

1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.
- I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
 2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
 3. Bolts over 1 3/4 inch diameter: 1 inch oversize.
- J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
 2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
 3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
 4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick
 5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
 6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
 7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick
- K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.
- F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- G. GALVANIZING
- H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Refer Section 01 45 23.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 12 13 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes architecturally exposed structural-steel framing.
 - 1. Requirements in Section 05 12 00 "Structural Steel Framing".
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 00 "Structural Steel Framing".

1.3 DEFINITIONS

- A. Architecturally Exposed Structural Steel: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within 96 inches (2400 mm) vertically and 36 inches (900 mm) horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within 20 feet (6 m) vertically and horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Indicate exposed surfaces and edges and surface preparation being used.
 - 6. Indicate special tolerances and erection requirements.
- B. Samples: Submit samples of AESS to set quality standards for exposed welds for Category 1 AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld ground smooth and blended.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and fabricator.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 1. Finish: Plain.

- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.2 PRIMER

- A. Primer: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: SSPC-Paint 20.

2.3 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 - 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
 - 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 - 4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
 - 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 - 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 - 7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 8. Fabricate Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
 - 9. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates for steel that is designated AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
 - 1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet (6 m) under any lighting conditions.
 - 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch (13 mm).
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch (0.8 mm) for Category 1 AESS.
- E. Bolt Holes: Cut, drill, mechanically (CNC) thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, mechanically (CNC) thermal cut, or punch holes perpendicular to steel surfaces.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.4 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 - 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 - 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 and 2 AESS is exposed to weather.
 - 4. Provide continuous welds of uniform size and profile where Category 1 and 2 AESS is welded.
 - 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus 0 inch (plus 1.5 mm, minus 0 mm) for Category 1 and Category 2 AESS.
 - 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 7. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
 - 8. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.

2.5 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 2. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 3. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
 - 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 1. Erect Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 2. Erect Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.

- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 - 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
 - 3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 13

SECTION 05 31 23 - STEEL ROOF DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Acoustical roof deck.
 - 3. Noncomposite vented roof deck.
- B. Related Requirements:
 - 1. Section 01 45 23 "Testing and Inspection Services"
 - 2. Section 05 12 00 "Structural Steel Framing".

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AWS D1.1 – Structural Welding Code
 - 2. AWS D1.3 – Structural Welding Code – Sheet Steel
 - 3. SDI – Design Manual
 - 4. SSPC – Painting Manual
 - 5. UL – Fire Resistance Directory
 - 6. ICBO – Product Evaluation Reports
 - 7. FM – Roof Assembly Classifications
- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.

- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.
 - 7. Epic Metals Corporation.

8. Marlyn Steel Decks, Inc.
 9. New Millennium Building Systems, LLC.
 10. Nucor Corp.; Vulcraft Group.
 11. Roof Deck, Inc.
 12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
 13. Verco Manufacturing Co.
 14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
 15. CSM Metal Deck
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 4. Deck Profile: As indicated on plan.
 5. Profile Depth: As indicated on plan.
 6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 7. Span Condition: Triple span or more.
 8. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Cordeck.
 6. DACS, Inc.
 7. Epic Metals Corporation.
 8. Marlyn Steel Decks, Inc.
 9. New Millennium Building Systems, LLC.
 10. Nucor Corp.; Vulcraft Group.
 11. Roof Deck, Inc.
 12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 3. Deck Profile: As indicated in Structural General Notes.
 4. Cellular Deck Profile: As indicated in Structural General Notes.
 5. Profile Depth: As indicated in Structural General Notes.
 6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.

7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
11. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
 - a. Factory install sound-absorbing insulation into cells of cellular deck.

2.4 NONCOMPOSITE VENTED ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Roof Deck, Inc.
 9. Verco Manufacturing Co.
 10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Roof Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
 1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 2. Profile Depth: As indicated in Structural General Notes.
 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 4. Span Condition: Triple span or more.
 5. Side Laps: Overlapped or interlocking seam at Contractor's option.
 6. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2.

2.5 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
 1. Fasteners shall provide diaphragm shear and uplift resistance equal to or greater than welding indicated herein and on Drawings.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 1. Weld Diameter: As indicated on Structural Plans.
 2. Weld Spacing: As indicated on Structural Plans.
 3. Weld Washers: Install weld washers at each weld location if deck gauge is lighter than 22 gauge.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals shown on Structural Plans:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 2. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
 1. Install reinforcing channels or zeeps in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 07 42 13 - METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

- A. ASTM International (ASTM)
 - 1. A792, Specifications for Steel Sheet, Aluminum-Zinc Alloy-Coated (Galvanized) by the Hot-Dip Process, General Requirements ("Galvalume")
- B. Underwriters' Laboratories (UL): UL 90

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer must have a minimum of ten (10) years experience manufacturing metal wall panels of the type specified for this Project. Panels specified in this Section shall be produced in either a factory environment with fixed-based roll forming equipment or by a certified manufacturer approved portable roll forming system to ensure the highest level of quality control. A letter certifying compliance shall accompany the product material submittal.
- B. Installer's Qualifications:
 - 1. Installer of the system shall be an approved installer, certified and authorized by the manufacturer as trained and qualified to install the manufacturer's product. Provide a letter of certification from manufacturer that installer has a minimum of three (3) year of metal wall panel installation experience preceding the date upon which work is to commence.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Include layouts of panels, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashing, closures and special details. Distinguish between factory and field assembly work.
- C. Calculations:
 - 1. Engineering calculations defining cladding loads on wall areas based on specified building codes, allowable clip loads and required number of fasteners to secure the panel clips to the designated substructure.
 - 2. Uplift loads on clip fasteners with full recognition of prying forces and eccentric clip loading. Calculate holding strength of fasteners in accordance with submitted test data provided by fastener manufacturer based on length of embedment and properties of materials.

- D. Samples:
 - 1. Color charts or samples from the manufacturer's standard line of Kynar 500 or Hylar 5000 finishes for Architect's selection.
 - 2. One (1) foot long sample of coated panel, including clips and fasteners.
- E. Certifications:
 - 1. Letter of certification from manufacturer that installer is in compliance and meets specified requirements.
 - 2. Letter of certification from manufacturer that panels have been produced in accordance with strictest applicable standards to ensure quality.
 - 3. Certified test results by a recognized testing laboratory or manufacturer's laboratory (witnessed by a professional engineer) in accordance with specified performance test methods for each panel system.
 - 4. Manufacturer's affidavit that materials used in Project contain no asbestos.
- F. Testing Reports: Showing metal panels have been tested in accordance with specified performance testing requirements.
- G. Sample Warranties: Submit proposed warranty meeting requirements of this Section.

1.5 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver metal wall system to job site properly packaged to provide protection against transportation damage.
- B. Handling: Exercise extreme care in unloading, storing and erecting metal wall system to prevent bending, warping, twisting and surface damage.
- C. Storage:
 - 1. Store all materials and accessories above ground on well skidded platforms.
 - 2. Store under waterproof covering.
 - 3. Provide proper ventilation of metal wall system to prevent condensation build-up between each panel or trim/flashing component.

1.7 WARRANTY

- A. Warrant the work specified herein against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship for a period of two (2) years. Field Reports are required throughout Project and are to be supplied by a Manufacturer's Approved Technical Inspector. Manufacturer's personnel are not acceptable for inspection. In addition, provide the following special warranty:
 - 1. Wall Panels and Finish:
 - a. The exterior color finish for painted wall panels shall be warranted by the Manufacturer for 20 years against chalking, blistering, peeling, cracking, flaking, checking and chipping.
 - b. The warranty shall be issued to the Owner by the Manufacturer at time of entire Project Substantial Completion.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Specifications are based on named products and manufacturers. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years experience manufacturing products meeting or exceeding the specifications and comply with requirements of Division 1 regarding substitutions to be considered.
1. AEP-Span, Dallas, TX; (214) 827-1740
 2. Architectural Building Components, Inc., Houston, TX; (800) 423-1105
 3. Berridge Manufacturing Co., Houston, TX; (800) 231-8127
 4. MBCI, Houston, TX; (281) 445-8555

2.2 MATERIALS

- A. Metal Wall Panel:
1. Materials:
 - a. Prefinished Sheet Material: 24 gauge thick Galvalume® steel sheet, minimum yield 50,000 PSI, roll formed in continuous lengths, ASTM A792.
 - b. Finish: Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000 finish supplier. Color shall be as selected by Architect from manufacturer's available colors. Interior surface finish shall be manufacturer's standard color.
 - c. Touch-up Paint: Paint burns, scars, welds, and damaged and rusted surfaces with cold galvanizing paint in accordance with ASTM A780. Acceptable Products include ZRC Cold Galvanizing Compound or Galviline manufactured by ZRC Worldwide, Marshfield, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawrence, MA; or paint complying with military specification MILP-21035A, Type I or II.
 - d. Strippable Film: Shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.
 - e. Accessories:
 - 1) Sealant: As specified in Section 07 92 00.
 - 2) Cold Formed Metal Framing: As specified in Section 05 40 00.
 - 3) Girts, Sub-girts, purlins: 16 gauge minimum thickness (55,000 psi minimum yield thickness) galvanized steel, with Stainless Steel screws to meet application.
 - 4) Fasteners: long-life, corrosion resistant screws supplied or instructed by panel manufacturer to suit application spaced according to UL requirements, color matched to match metal panel color.
 - 5) Clips, miscellaneous fasteners: galvanized steel as supplied or instructed by panel manufacturer.
 - 6) Metal Trim, closures, and flashing: Exposed adjacent flashing shall be the same material and finish as panel system.
 - 7) Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.

8) Dampproofing: refer to section 07 11 00.

2. Profile/Dimensions: 7/8 inch thick panel 16 inch coverage width, in continuous length up to 40 feet-0 inches, with interlocking design with concealed fasteners.
3. Approved Product/Manufacturer: 'HR-16' Panel manufactured by Berridge Manufacturing Co., Houston, TX; (800) 231-8127, or Architect approved equal.

2.3 FABRICATION

- A. All exposed adjacent flashing shall be of the same material and finish as the siding panels.
- B. Hem all exposed edges of flashing on underside, 1/2 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine metal frame to insure it is prepared to receive siding.
- B. Ensure substrates are flat, free from objectionable warp, wave and buckle

3.2 INSTALLATION OF SIDING PANELS

- A. Comply with manufacturer's instructions for assembly, installation and erection in order to achieve weathertight installation.
- B. Install horizontal girts on metal studs at 5'-0-1/4" vertically.
- C. Install exterior sheathing on girts.
- D. Install dampproofing on exterior sheathing in accordance with Section 07 11 00. Seal all joints and penetrations.
- E. Fasten siding panels along each girt. Comply with UL90 Construction #79 or #161 for installation and fastening of panels to substrate to meet application.
- F. Install closures and trim to form a complete installation.
- G. Install sheet metal flashings according to provisions of Section 07 62 00.

3.3 CLEANING AND PROTECTION

- A. Remove scraps and debris and leave work area clean.
- B. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on prefinished metal by painting with a compatible paint in color to match undamaged finish.
- C. Clean other work damaged or soiled by Work of this Section.
- D. Protect finished work from damage.

3.4 INSPECTION

- A. Architect reserves the right to have the work inspected during application. Upon completion of the work, if inspection discloses that siding 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 at no additional expense to Owner.

END OF SECTION 07 42 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Insulated service doors.
 - 2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: Indicated on Drawings.
 - 2. Testing: According to ASTM E 330.
 - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283].
- D. STC Rating: 26.
- E. Curtain R-Value: 5.0 degrees F x h x sq. ft./Btu (0.881 K x sq. m/W).
- F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 100,000 cycles for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.

1.4 SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 2. Include description of automatic closing device and testing and resetting instructions.
- B. Shop Drawings: Submit plans, elevations, sections, and mounting details.
 - 1. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 5. Show locations of controls, locking devices, replaceable fusible links, and other accessories.
 6. Include diagrams for power, signal, and control wiring.
- C. Samples: Submit samples for exposed metal finish in standard sizes.
- D. Delegated Design Submittal: Submit delegated design including analysis data signed and sealed by the professional engineer licensed in the State of Texas who is responsible for the preparation.
- E. Oversize Construction Certification: For door assemblies required to be fire rated and that exceed size limitations of labeled assemblies.
- F. Maintenance Data: Submit for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. 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.
 2. Temperature Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control: In corridors and smoke barriers, provide doors UL listed and labeled with the letter "S" on the fire rating label for smoke and draft control based on testing according to UL 1784; with maximum air leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.
 4. Sound Control Doors: Assemblies tested in a laboratory for sound transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
 5. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS).
- B. Installer Qualifications: Entity having minimum 5 years documented experience who employs installers and supervisors trained and approved by manufacturer for both installation and maintenance of units required.
- C. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling door manufacturer.

1.6 WARRANTY

- A. Warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

PART 2 - PRODUCTS

2.1 DOOR ASSEMBLY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Clopay Building Products.
 2. Cookson Company.
 3. Cornell Iron Works, Inc.
 4. McKeon Door Company, Inc. as distributed by Griesenbeck.
 5. Overhead Door Corporation.
 6. Wayne-Dalton Corp.
 7. Holiday Gate & Door Systems Inc.
- B. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
- C. Door Curtain Slats: Flat profile slats of 2-5/8 inch (67 mm) center to center height.
1. Gasket Seal. Continuous gaskets between slats.
- D. Bottom Bar: Two angles, each not less than 1-1/2 inch by 1-1/2 inch by 1/8 inch (38 mm by 38 mm by 3 mm) thick; fabricated from aluminum extrusions and finished to match door.
- E. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.
- F. Hood: Match curtain material and finish.
1. Shape: Round.
 2. Mounting: Between jambs.
- G. Locking Devices: Equip door with locking device assembly.
1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside and outside with cylinders.
- H. Electric Door Operator:
1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 2. Operator Location: Top of hood.
 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
 4. Motor Exposure: Exterior, wet, and humid.
 5. Emergency Manual Operation: Chain type.
 6. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom bar
 - a. Sensor Edge Bulb Color: Black.
 7. Control Station(s): Where shown on Drawings.
- I. Curtain Accessories: Equip door with weatherseals, astragal, push/pull handles and automatic closing device.

- J. Door Finish:
 - 1. Aluminum Finish: Color as selected by architect from manufacturers full range of colors
 - 2. Interior Curtain Slat Facing: Match finish of exterior curtain slat face.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Aluminum Door Curtain Slats: ASTM B 209 (ASTM B 209M) sheet or ASTM B 221 (ASTM B 221M) extrusions, alloy and temper recommended by manufacturer for type of use and finish indicated; thickness of 0.050 inch (1.27 mm); and as required.
 - 2. Insulation: Fill slats for insulated doors with thermal insulation complying with maximum flame spread and smoke developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain Slat Facing: Match metal of exterior curtain slat face, with minimum aluminum thickness of 0.032 inch (0.80 mm).
- B. Curtain Jamb Guides: Angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.3 HOODS

- A. Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface mounted hoods and fascia for any portion of between jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028 inch (0.71 mm) thick, hot dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
 - 2. Stainless Steel: 0.025 inch (0.64 mm) thick stainless steel sheet, Type 304, complying with ASTM A 666.
 - 3. Aluminum: 0.040 inch (1.02 mm) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
 - 4. Exterior Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant joint bead profile for applying joint sealant.

2.4 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Refer to Section 08 71 00.
 - 2. Keys: Refer to Section 08 71 00.
- B. All rollup doors and keyed switches must have standard keyed lock and box that is keyed to the building master key system.
 - 1. Exterior basis of design: Primus as manufactured by Schlage.
 - 2. Interior basis of design: Schlage.
- C. Chain Lock Keeper: Suitable for padlock.

- D. Safety Interlock Switch: Equip power operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather stripping gaskets fitted to entire exterior perimeter of door for weather resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8 inch (3 mm) thick, replaceable, continuous sheet baffle secured to inside of hood or field installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8 inch (3 mm) thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal for Interior Doors: Equip each door bottom bar with replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Push/Pull Handles: Equip each push up operated or emergency operated door with lifting handles on each side of door, finished to match door.

2.6 COUNTERBALANCING MECHANISM

- A. Counterbalance doors using standard mechanism with adjustable tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot formed, structural quality, seamless or welded carbon steel pipe, of sufficient diameter and wall thickness to support rolled up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil tempered, heat treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast steel barrel plugs.
 - 1. Fire Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of cold rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Mounting brackets fabricated from either cast iron or cold rolled steel plate.

2.7 ELECTRIC DOOR OPERATORS

- A. Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation cycles requirement specified, with electric motor and factory prewired motor controls, starter, gear reduction unit, solenoid operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

- C. Door Operator Location(s): Operator location indicated for each door.
 - 1. Top of Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
 - 2. Front of Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
 - 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
 - 4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
 - 5. Through Wall Mounted: Operator is mounted on other side of wall from coil side of door.
- D. Motors: Reversible type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Polyphase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 - 2. Motor Size: Minimum size large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 - 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Standard unless otherwise indicated.
 - 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Coiling doors shall be powered with manual override. At corridors they shall be interlocked with the Fire Alarm system and the security for campus lock down.
- G. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. At all corridors coiling doors shall be interlocked with fire alarm system. For nonfire rated doors, activation of device immediately stops and reverses downward door travel. For fire rated doors, activation delays closing.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
 - 2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using take up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
 - 3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

- H. Control Station: Key controlled in fixed location labeled *Open* and *Stop* and sustained or constant pressure key control labeled *Close*.
 - 1. Interior Mounted Units: Full guarded, surface mounted, heavy duty type, with general purpose NEMA ICS 6, Type 1 enclosure.
 - 2. Exterior Mounted Units: Full guarded, standard duty, surface mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- I. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- J. Emergency Operation Disconnect Device: Equip operator with hand operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- K. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- L. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- M. Portable Radio Control System: Consisting of one of the following per door operator:
 - 1. Three channel universal coaxial receiver to open, close, and stop door.
 - 2. Portable control device to open and stop door may be momentary contact type; control to close door shall be sustained or constant pressure type.
 - 3. Remote antenna mounting kit.

2.8 FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA *Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)* for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Finishes:
 - 1. Aluminum finish: Dark Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire Rated Doors: Install according to NFPA 80.
- E. Smoke Control Doors: Install according to NFPA 80 and NFPA 105.
- F. Power Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

- A. Engage a factory authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so doors operate easily, free of warp, twist, or distortion. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 09 65 13 - RESILIENT BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Rubber base.
 - 2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of product including manufacturer's installation instructions.
- B. Samples: Sample of Base Selected or Color Chart if none selected.
- C. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store base and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
- C. Close spaces to traffic for 48 hours after installation.

1.7 EXTRA STOCK

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Base: 1 percent of quality installed or 2 full unopened containers, whichever is greater.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Product: Manufacturers and tile series, pattern, and color selections are indicated in the Finish Schedule and are a basis of design. Subject to compliance with requirements, provide product indicated in Finish Schedule or comparable product by one of the following:
 - 1. Flexco Floors.
 - 2. Johnsite, a division of Tarkett Group.
 - 3. Mannington Commercial.
 - 4. Roppe.
- B. Rubber Base (RB-1): ASTM F1861.
 - 1. Basis of Design: Pinnacle Type TS as manufactured by Roppe.
 - 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B.
 - 3. Manufacturing Method: Group I (solid, homogeneous).
 - 4. Style: Topset cove; minimum 100 foot coil, cut to length required.
 - 5. Minimum Thickness: 0.125 inch (3.2 mm).
 - 6. Color: Architect to Select from Manufacturer's full range of colors.
 - 7. Height: 4 inches, unless indicated otherwise.
 - 8. Outside Corners: Job formed.
 - 9. Inside Corners: Job formed.
- C. Adhesives: Water resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified for other work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Immediately before installation, sweep clean substrates to be covered by resilient base.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including

cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.

- B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- C. Resilient Base: Comply with manufacturer's written instructions for installing resilient base. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 1. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
 - 2. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Do not stretch resilient base during installation.
 - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
 - 5. Preformed Corners: Install preformed corners before installing straight pieces.
 - 6. Job Formed Corners:
 - a. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - b. Form without producing discoloration (whitening) at bends.
 - c. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - 1) Miter or cope corners to minimize open joints.

END OF SECTION 09 65 13

SECTION 09 65 23 – LUXURY VINYL TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Luxury vinyl floor tile.
 - 2. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

- A. Section 09 65 13 – Resilient Base.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product including manufacturer's installation instructions.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: Full size units of each color and pattern of floor tile required.
 - 1. Luxury Vinyl Tile (LVT) flooring: 18 inch by 18 inch (460 mm by 460 mm) tile in each color selected and 12 inch long piece of base material in each color selected for approval.
- D. Product Schedule: Submit for floor tile using same designations indicated on Drawings.
- E. Maintenance Data: Submit for inclusion in maintenance manuals.
- F. Reports: Certified Moisture Testing Results.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Test Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 - b. Smoke Density: Maximum specific optical density of 450 per ASTM E 662 or NFPA 258.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.

- B. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.
- D. Source Limitations:
 - 1. Tile: Obtain floor products of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 - 2. Setting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Where demountable partitions, cabinets, and similar items are indicated for installation on top of resilient tile flooring, install tile before these items are installed.
- F. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.
- G. Install flooring after other finishing operations, including painting, have been completed.

1.8 WARRANTY

- A. Warrant the Work specified herein for twenty (20) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Damaged tile, including broken or chipped edges.
 - 2. Loose or missing tile.
 - 3. Noticeable deterioration or discoloring of tile or grout.

1.9 EXTRA STOCK

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
 - 1. LVT Flooring: 1 percent of quality installed or 2 full unopened containers, whichever is greater.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Product: Manufacturers and tile series, pattern, and color selections are indicated in the Finish Schedule and are a basis of design. Subject to compliance with requirements, provide product indicated in Finish Schedule or comparable product by one of the following:
 - 1. Luxury Vinyl Tile (LVT):
 - a. Basis of Design: Mannington Commercial . Other acceptable manufacturers include Karndean, Aspecta, Armstrong, Patcraft, Mohawk, Tandus Centiva, an Tarkett Company, or comparable product.
- B. Luxury Solid Vinyl Tile (LVT-1): ASTM F 1700.
 - 1. Class: Class I, monolithic vinyl tile.
 - 2. Type: A, smooth surface and B, embossed surface.
 - 3. Thickness: 0.125 inch (3.2 mm).
 - 4. Size: Refer to Finish Schedule and Elevations.
 - 5. Construction: Heterogeneous Resilient Flooring with .030" (30 mil) high density wear layer.
 - 6. Colors: As selected by Architect from manufacturer's full range of colors.
 - 7. Patterns: Factory mounted patterns as selected by Architect.
- C. Trowelable Leveling and Patching Compounds: Latex modified, portland cement based formulation provided or approved by floor tile manufacturer for applications indicated.
- D. Adhesives: High-strength, high-track type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated for quick dry time.
- E. Floor Polish: Provide protective, liquid floor polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified for other Work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 95 percent relative humidity level.
 5. Bond Test: Bond 3' x 3' panels spaced 50 feet apart throughout subfloor area. After moisture test proves floor acceptably dry, install panels using adhesive. If panels are securely bonded after 72 hours, subfloor is sufficiently clean of foreign materials for satisfactory installation of resilient flooring.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

- C. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis.
- D. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction.
- E. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built in furniture, cabinets, pipes, outlets, and door frames.
- F. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- H. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- I. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- J. Floor Tile: Comply with manufacturer's written instructions for installing floor tile.
 - 1. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - a. Lay tiles square with room axis unless pattern indicated for an area.
 - 2. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles. Lay tiles with grain running in one direction.
- K. Resilient Accessories: Comply with manufacturer's written instructions for installing resilient accessories.
 - 1. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp mop surfaces to remove marks and soil.

- C. Protect floor tile from mars, marks, indentations, and damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish. Apply two coat(s).
- E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
 - 1. Sealer: Apply two base coats of liquid sealer.
 - 2. Finish: Apply two coats of liquid floor finish.
- F. Cover floor tile until Substantial Completion.
- G. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.
 - 1. Before cleaning, strip protective floor polish.
 - 2. Reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations.

END OF SECTION 09 65 23

SECTION 10 14 00 - GRAPHICS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Cast character for exterior signage.
 - 2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of signage.
- B. Signage Shop Drawings: Submit fabrication and installation details and attachments to other Work.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- D. Certifications: Submit letter of certification from manufacturer that installer and manufacturer is in compliance and meets specified requirements.
- E. Samples:
 - 1. One (1) 6 inch x 6 inch sample of cast material signage with specified letter style and finish.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code/City Code: Comply with building code and local ordinances for exterior signage.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Installer has minimum five (5) Years documented experience in the manufacture of signage and who employs installers and supervisors trained and approved in installation methods for each type of signage.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.6 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Manufacturer: South Texas Graphics; (713) 467-4499. Other manufacturers shall have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified and shall comply with Division 1 requirements for substitutions in order to be considered.
 - 1. Aria Signs; (713) 259-3737.
 - 2. A.R.K. Ramos Architectural Signage Systems; (405) 235-5505.
 - 3. InPro Corporation (IPC); (800) 222-5566.
 - 4. Mountain Commercial Graphics; (713) 996-6634.
 - 5. ProWorx Architectural Signage; (713) 666-3131.
 - 6. Riot Creative Imaging; (713) 988-9200.
 - 7. Stanley Signature Signs; (281) 395-6106.
 - 8. The Southwell Co.; (210) 223-1831.
- B. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- C. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.
- F. Accessories:
 - 1. Fasteners and Anchors: As necessary for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - a. Use concealed fasteners and anchors unless indicated to be exposed.
 - b. Exposed Metal Fastener Components: Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
- G. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles:
 - 1. Character Material: Cast aluminum.

2. Character Height: Indicated on Drawings.
3. Finishes:
 - a. Color Anodized Finish: Black.
4. Mounting: Refer to the Drawings.
5. Typeface: Selected by Architect.

2.2 FABRICATION

- A. Provide sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.
 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing Work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket mounted signs to suit sign construction and mounting conditions indicated. Modify brackets as necessary.
 1. Aluminum Brackets: Factory finish brackets with powder coat finish to match sign background color unless otherwise indicated.

2.3 FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Aluminum Finishes:
 1. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of signage Work. Verify sign support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify sign surfaces are clean and free of materials or debris that impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 - 2. Shim Plate Mounting: Provide 1/8 inch (3 mm) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 10 21 17- SOLID PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Solid Phenolic (SPC) Core toilet partitions, floor mounted, overhead braced.

1.3 SUBMITTALS

- A. Shop Drawings: Within four (4) weeks of award of contract, submit:
 - 1. Complete shop drawings for the Architect's approval, showing all required field measurements, all details and elevations, plans and sections required to indicate all conditions.
 - 2. Manufacturer's installation instructions.
- B. Certification: Provide a certificate of compliance attesting that all materials are in accordance with manufacturer's specifications.

1.4 FIELD MEASUREMENTS

- A. Field verify dimensions prior to submittals and fabrication.

1.5 WARRANTY

- A. Furnish twenty-five year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Any one (1) of the following manufacturers whose product meets or exceeds the specifications for those specified is approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified for design, size, finish, and fabrication and comply with Division 1 requirements for substitutions in order to be considered.
 - 1. Accurate Partitions Corporation, Lyons, IL
 - 2. Ampco Products, Inc., Sanger, TX
 - 3. Bobrick Washroom Equipment, Inc., North Hollywood, CA
 - 4. Bradley Corporation, Menomonee Falls, WI
 - 5. DesignRite Partitions (Spec-Rite Designs), St. Louis, MO
 - 6. Flush-Metal Partition, Maspeth, NY
 - 7. General Partitions Mfg. Corp., Erie, PA
 - 8. Global Steel Products Corp., Deer Park, NY
 - 9. Knickerbocker Partition Corp., Irving, TX
 - 10. Metpar Corp., Westbury, NY

11. Columbia Partitions, a Division of PSiSC, Columbia, SC
12. Tex-Lam Manufacturing, Inc., Houston, TX

2.2 MATERIALS

- A. General: Comply with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS).
- B. Doors: $\frac{3}{4}$ inch thick solid phenolic core with high pressure melamine color surface on faces. Edges shall be burnished and slightly rounded. Standard door size, other than "accessible", is 24 inches, unless indicated otherwise.
- C. Panels: $\frac{3}{4}$ inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.
- D. Pilasters: Pilaster Shoes and Sleeves (Caps): Stainless steel.
 1. Pilaster shall be attached to the floor by means of an 11 gauge stainless steel footer, with provisions for leveling, attached to two (2) $\frac{3}{8}$ inch diameter stainless steel studs set into expansion shields. The floor connections are to be covered by a four (4) inch high stainless steel shoe, #4 finish.
 2. Option Panels: $\frac{3}{4}$ inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.
- E. Headrail: heavy duty aluminum extrusions, anodized with anti-grip configuration, and shall be fastened to the pilaster tops.
- F. Hardware and Accessories: Heavy duty operating hardware and accessories.
 1. Hinges: 16-gauge continuous piano, self-closing hinge. Continuous piano hinge shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable.
 2. Latch and Keeper: Heavy duty surface mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
 3. Coat Hook: Heavy duty combination cast stainless steel hook and rubber tipped bumper, sized to prevent in swinging door from hitting compartment mounted accessories. Mount with through bolts.
 4. Door Bumper: Heavy duty rubber tipped cast stainless steel bumper at out swinging doors and entrance screen doors. Mount with through bolts.
 5. Door Pull: Heavy duty cast stainless steel pull at out swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.
- G. Finish: Melamine color surface on material face, edges burnished. All wood grain panels larger than 57-1/4 inches will have horizontal grain.
- H. Color: Shall be selected from the manufacturer's high pressure plastic laminate color chart. The colors available shall be the same as offered for plastic laminate partitions. Core shall be color-thru.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Install all toilet partitions where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for long life under hard use and in complete accordance with the manufacturer's recommendations.
- C. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.

3.2 CLEANING AND ADJUSTING

- A. Clean surfaces free of dirt, oil, grease and other contaminants which detract from appearance of partitions.
- B. Except for compartments for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

3.3 REPLACEMENT OF DEFECTIVE MATERIALS

- A. Defaced, damaged, scratched or marred materials will not be permitted, will be considered defective, and rejected. Rejected materials shall be replaced with new materials at no additional expense to Owner.

END OF SECTION 10 21 17

SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Public use washroom accessories.
 - 2. Public use shower room accessories.
 - 3. Private use bathroom accessories.
 - 4. Warm air dryers.
 - 5. Childcare accessories.
 - 6. Underlavatory guards.
 - 7. Custodial accessories.
 - 8. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 2. Include electrical characteristics.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 1. Approved full size Samples will be returned and may be used in the Work.
- C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.
- D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Source Limitations: Obtain products from single source from single manufacturer.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Toilet accessories schedule is based on Bobrick Washroom Equipment unless noted otherwise. Subject to compliance with requirements, provide products by one of the following:
 - 1. AJW Architectural Products.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. Brey-Krause Manufacturing Co.
 - 6. GAMCO Specialty Accessories; a division of Bobrick.
 - 7. Tubular Specialties Manufacturing, Inc.
- B. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- C. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- D. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- E. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot dip zinc coating.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick.

2.2 COMPONENTS

- A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 1. Material and Finish: Antimicrobial, molded plastic, white.

2.3 FABRICATION

- A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of [six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 - SCHEDULE

4.1 ACCESSORY SCHEDULE

- A. As a quality standard, Model Numbers shown which are not Owner furnished are products of Bobrick Washroom Equipment, Inc.

WASHROOM EQUIPMENT

- 1. TA-1 - Soap Dispensers: (Owner Furnished, Contractor Installed)
 - a. Mounting: Surface.
 - b. Locations: One (1) at each lavatory. Refer to drawings.
- 2. TA-2 - Mirrors:
 - a. Mounting: Surface.
 - b. Model No.: B-290.
 - c. Size/Locations: 24 inches x 48 inches, unless shown otherwise. One (1) at each lavatory. Refer to drawings.
- 3. TA-3 - Toilet Paper Dispenser: (Owner Furnished, Contractor Installed)
 - a. Mounting: Surface.
 - b. Locations: One (1) at each water closet. Refer to drawings.
- 4. TA-4 - Paper Towel Dispenser: (Owner Furnished, Contractor Installed)
 - a. Locations: Refer to drawings.
- 5. TA-5 - Grab Bars: (At Typical Accessible Toilet Stalls)
 - a. Size/Finish: 1-1/2 inch diameter Satin Finish Stainless Steel.
 - b. Clearance: 1-1/2 inch between rail and wall.
 - c. Model No.: B-6806.
 - d. Mounting: Attach with concealed mounting. Mount parallel to floor.
 - e. Location: One (1) 36 inch behind toilet, and one (1) 42 inch long bar at side of toilet, at each accessible stall. Refer to drawings.
- 6. TA-6 – Not Used

7. TA-7 - Sanitary Napkin Disposal:
 - a. Mounting: Surface
 - b. Model No.: B-270
 - c. Locations: One (1) at each Staff toilet room, and Toilet Rooms D111, D112, D124, C719, and C722. Refer to drawings.
8. TA-8 – Not Used
9. TA-9 – Not Used
10. TA-10 – Not Used
11. TA-11 - Clothes Hook:
 - a. Mounting: Surface
 - b. Model No.: B-6717; or equivalent.
 - c. Toilet Partitions: One (1) hook at each toilet stall provided by toilet partition manufacturer included in standard hardware package
11. TA-12 – Not Used
13. TA-13 – Not Used
14. TA-14 - Not Used
15. TA-15 - Grab Bars: (At Additional Accessible Toilet Stalls)
 - a. Size/Finish: 1-1/2 inch diameter Satin Finish Stainless Steel.
 - b. Clearance: 1-1/2 inch between rail and wall.
 - c. Model No.: B-6806.
 - d. Mounting: Attach with concealed mounting. Mount parallel to floor.
 - e. Location: One (1) 36 inch at each side of toilet, at each accessible stall. Refer to drawings.
16. TA-16 - Diaper Changing Stations:
 - a. Type: Horizontal station to accommodate infants and toddlers.
 - b. Construction and Features:
 - c. FDA approved high-impact molded polyethylene with steel-on-steel hinge system. Fabricate to withstands static loads over 400 pounds.
 - d. Child protection straps with snap-lock fasteners.
 - e. Built in diaper bag hooks.
 - f. Built-in sanitary liner dispensers. Liners shall be 3-ply, biodegradable.
 - g. Premium gas spring mechanism.
 - h. Molded usage and safety instructions in six (6) languages and Braille.
 - i. ADA compatible.
 - j. Anti-fungal to comply with ASTM standards.
 - k. Color: Beige or light gray as selected by Architect.
 - l. Dimensions: 35 inches long by 20 inches high by 4 inches deep.
 - m. Approved Product/Manufacturer: Koala Bear Kare Baby Changing Stations as manufactured by Koala Bear Kare®, Englewood, CO; (888) - 733-3456, or Architect approved equal.
12. TA-17 – Not Used
13. TA-18 – Not Used

END OF SECTION 10 28 13

SECTION 12 36 61 - SOLID SURFACE MATERIAL

FABRICATIONS PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Section 01 60 16 – Interior Design Selections

1.2 SECTION INCLUDES

- A. Solid polymer countertops

1.3 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry

1.4 REFERENCES

- A. Applicable Standards:
 - 1. American National Standards Institute (ANSI)
 - 2. ASTM International (ASTM)
 - 3. National Electrical Manufacturers Association (NEMA)

1.5 SUBMITTALS

- A. Product Data:
 - 1. Indicate product description, fabrication information, and compliance with specified performance requirements.
 - 2. Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in project close-out documents.
- B. Shop Drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions, and coordination requirements with adjacent work.
- C. Samples:
 - 1. Submit minimum 2 inches by 2 inches samples. Indicate full range of color and pattern variation for Architect's selection.
 - 2. Submit 12 inch long by 4 inches wide sample in color and pattern selected and approved by Architect. Approved sample will be retained as standards for work.

1.6 QUALITY ASSURANCE

- A. Allowable Tolerances:
 - 1. Variation in Component Size: Plus or minus 1/8 inch.
- B. Fabricator/Installer Qualifications: Approved by manufacturer of solid polymer manufacturer.

- C. Mock-Up(s):
 - 1. Prior to final approval of shop drawings, erect one full-size mock-up of each component at project site for Architect review.
 - 2. Rework or remake mock-up until accepted; remove rejected units from project site. Acceptable mock-ups shall remain as part of finished work.
- D. Provide all solid polymer fabrications from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components to project site when areas are ready for installation. Store components indoors prior to installation.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.8 WARRANTY

- A. Warrant the work specified herein for 15 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Shrinking, warping, cracking, chipping, splitting, or deteriorating excessively.
 - 2. Becoming loose from substrate.
 - 3. Inadequate color depth

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on Corian manufactured by E. I. du Pont de Nemours and Company; (800) 426-7426, or Architect approved equal. Listed manufacturers whose products meet or exceed those specified are approved for use on this Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered. Refer to section 01 60 16 – Interior Design Selections.

2.2 MATERIALS

- A. Material, General: Homogeneous filled acrylic; not coated, laminated or of composite construction; meeting ANSI Z124.3 & .6, Type Six.
 - 1. Superficial damage to a depth of 0.010 inch shall be repairable by sanding and polishing.
- B. Performance Characteristics:
 - 1. Tensile Strength: 5,500 psi, minimum, ASTM D638
 - 2. Flexural Strength: 11,424 psi, minimum, ASTM D790
 - 3. Color Stability: No change, 100 hours minimum, NEMA LD3.1
 - 4. Abrasion Resistance: No loss of pattern, NEMA LD3.1
 - 5. Flame Spread / Smoke Development: Class I/Class A, ASTM E-84
- C. Countertops:
 - 1. Material: 1/2 inch thick countertop of solid polymer material.

2. Edge Details: As indicated on the drawings.
3. Sink: Drop-in sink shown on drawings
4. Fabrication: Provide counter complete with backsplash of size shown on the drawings.
5. Color/Finish: Refer to section 01 60 16 – Interior Design Selections.

2.3 ACCESSORY PRODUCTS

- A. Joint Adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, nonporous joints, with chemical bond.
- B. Sealant: Manufacturer's standard mildew-resistant, FDA/UL recognized silicone sealant in color-matching or clear formulations.

1.9 FABRICATION

- A. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and solid polymer manufacturer requirements.
- B. Form joints between components using manufacturer's standard joint adhesive, joints inconspicuous in appearance and without voids. Attach 2 inch wide reinforcing strip of solid polymer material under each joint.
- C. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
- D. Finish all surfaces uniformly, matte: Gloss rating of 5-20.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
- B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

3.2 CLEANING AND PROTECTION

- A. Keep components and hands clean during installation. Remove adhesives, sealants, and other stains. Components shall be clean on Date of Substantial Completion.
- B. Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged work that cannot be repaired to architect's satisfaction and invoice for the cost of repairs; before repairs are made, cost estimates are subject to architect's approval.

3.3 MAINTENANCE INFORMATION

- A. Provide Care and Maintenance information to Owner upon completion of Project.
- B. Review maintenance procedures and warranty details with the Owner upon completion of project.

END OF SECTION 12 36 61

SECTION 13 34 16 - PERMANENT GRANDSTAND SEATING (SOFTBALL/BASEBALL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SYSTEM DESCRIPTION

- A. Provide labor, material, equipment and supervision necessary to complete installation of permanent steel grandstand, including the following:
 - 1. Steel Substructure
 - 2. Decking System
 - 3. Concrete Foundation

1.2 RELATED SECTIONS

- A. Section 02 32 00 - Geotechnical Report
- B. Section 05 12 00 - Structural Steel Framing
- C. Section 05 50 00 – Metal Fabrications
- D. Section 31 20 00 - Earthwork
- E. Section 03 30 00 - Cast-In-Place Concrete

1.3 REFERENCES

- A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2004.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
- C. ASTM A 123 / A 123M - Standard Specification for Zinc (Hot-Dip) Coatings on Iron and Steel Products
- D. ASTM A 153 / A 153M - Standard Specification for Zinc Coating (Hot-Dip Galvanized) on Iron and Steel hardware.
- E. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
- F. AWS D1.1 - Structural Welding Code - Steel
- G. AWS D1.2 - Structural Welding Code - Aluminum

1.4 QUALITY ASSURANCE

- A. AISC Certification: All structural steel shall be fabricated in an AISC certified plant that is certified "BU" – Certified Building Fabricator at the time of bid. The manufacturer bidding on the project shall be listed on the AISC website as a certified fabricator.
- B. Manufacturer Qualifications: Obtain required products from a single manufacturer with a minimum of ten (10) years of experience in the design and manufacture of permanent grandstands.

- C. Installer Qualifications: Installer must be acceptable to or licensed by the manufacturer of products being installed.
 - D. Professional Structural Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind required. Engineering services are defined as those performed for installations that are similar to those required for this Project in material, design, and extent.
 - E. Pre-installation Conference: Prior to installation of work of this section, conduct a meeting at the project site to discuss quality assurance requirements. In addition to the Contractor and the installer, arrange for the attendance of the following:
 - a Other installers who are affected by the work of this section.
 - b Manufacturer's representative. F.
- Welders: AWS certified.
- G. All material and workmanship shall be in accordance with AISC Manual of Steel Construction, Load & Resistance factor Design, 2nd Edition.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let based on such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusion of adequate labor and materials to cover the proper and timely fabrication and installation of the permanent grandstands as indicated, described, or implied.
- B. As a performance specification, the criteria for the solution of structurally sound permanent grandstands indicated on the Drawings or specified herein are for the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the permanent grandstands is totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design intent, the decision of the Owner shall take precedence.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
- B. Shop Drawings:

1. Complete shop drawings for the Architect's review for type, location, quantity, and details of steel and aluminum components required for project.
 2. Unit layout for Owner's approval.
 3. Design Calculations:
 - a. All structural elements and connections shall be designed by the Contractor.
 - b. Design calculations shall be submitted prior to or with the shop drawings.
 - c. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
 - d. Shop drawings containing connections for which calculations have not been received will be returned unchecked as an incomplete submittal.
 - e. Design Calculations will be retained for the Architect's file and will not be approved or returned.
- C. Certificates:
1. Insurance Certificate
 2. Proposal Bond
- D. Product Sample: Submit one (1) 18-inch seat sample. Include color charts, if applicable, showing manufacturer's full range of colors for Architect's selection.
- E. Refer to Section 01 41 00, Regulatory Requirements, 1.2 Quality Assurance, Paragraph G. regarding Texas Department of Insurance Windstorm Inspection Program for Inland II requirements.

1.7 SITE CONDITIONS A.

Field Site:

1. Owner to make site accessible.
 2. Owner to verify site locations, benchmarks.
- B. Underground Utility Line: Owner to clearly mark all underground utilities and obstructions and Owner to relocate all that conflict with grandstand. C. Soil Test: Furnished by Owner.

1.8 BUILDING CODES

- A. The project shall meet the requirements of the ICC 2021 International Building Code.

1.9 WARRANTY

- A. Permanent grandstands shall be under warranty for a period of one (1) year beginning at Date of Substantial Completion for Projects installed by Manufacturer. The Grandstand is warranted to be free from defects in materials and workmanship during manufacture. This warranty excludes any other defects resulting from abnormal use in service, accidental or intentional damage or any occurrences beyond Manufacturer's control.

1.10 MAINTENANCE

- A. The Owner is to conduct annual inspection and required maintenance of grandstand to assure safe conditions. It is also recommended that a professional engineer perform inspections biannually.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Specifications are based on Leg Truss Design product of Sturdisteel, Waco, Texas; (800) 433-3116., www.sturdisteel.com. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Sturdisteel, Waco, Texas; (800) 433-3116.
 2. Southern Bleacher Co., Graham, Texas.
 3. American Grandstands, Inc.; Dallas, Texas.
 4. Martco MFG, LLC; Jacksboro, Texas.
 5. Outdoor Aluminum, Geneva, Alabama; (334) 684-2231.

2.2 PERMANENT STEEL GRANDSTAND – LEG TRUSS DESIGN

- a. Horizontal Beam Design:
 - i. Vertical columns are placed roughly 18 ft. on center laterally. All column beams are wide flange.
 - ii. Traverse bays are free of cross bracing the total length of the grandstand.
 - iii. Stringers are wide flanges with steel angle rise and depth fabrication and are placed 6 feet on center.
- b. Aluminum Decking System - Interlocking Deck:
 - i. The intent of the product design is to reduce deflection of aluminum deck.
 - ii. All individual deck members shall be locked together longitudinally at all treads, front walk and cross walk locations.
 - iii. This design, in ambient conditions, allows for expansion and contraction without damage or deformation of the aluminum deck.
- c. Front Walkway:
 - i. Elevated per plans.
- d. Entry stairs to be firmly anchored to uniformly poured concrete bases.
 - i. Stair rise: max. (7) Inches per IBC Building Code with aluminum closure.
 - ii. Stair tread depth: min. (11) inches per IBC Building Code.
 - iii. Guardrails on Stair to be (42) inches above leading edge of step with intermediate rails.
 - iv. Stairs to have handrail extensions. The handgrip portion of handrails shall not be less than 1 1/2 inches or more than 2 inches in cross-sectional dimension or the shape shall provide an equivalent gripping surface. The handgrip portion of handrails shall have a smooth surface with no sharp corner. The top of handrails and handrail extensions shall be placed not less than 34 inches or more than 38 inches above the nosing of treads and landings. Handrails shall be continuous the full length of the stairs and shall extend in the direction of the stair run not less than 12 inches beyond the bottom riser. Ends shall be returned or shall terminate in newel posts or safety terminals.
- e. Aisles:
 - i. Aisles with seating on both sides to have 34-inch-high handrail with intermediate rail at approximately 22 inches above tread.
 - ii. Anodized aluminum handrails with rounded ends (no fittings) are discontinuous to allow access to seating through a space 22 inches (min.) to 36 inches (max.).
 - iii.

Intermediate steps shall provide equal rise and run throughout aisle. Each shall have aisle nosing with Dur-Kyn finish and riser closure with Dur-Kyn finish.

- f. Seating and Riser / Tread Configurations:
 - i. Rise and depth at each row are per plan.
 - ii. Each seat is 17 inches above its respective tread.
 - iii. Seating Selections:
 - 1. The seats shall be 2"x10" (1 ½" x 9 ½") seat plank with two internal legs and extruded aluminum alloy, 6063-T6 with clear anodized 204R1, AAM10C22A31, Class II finish. Mounting brackets to be "L" type riser mounted aluminum.
 - 2. The tread system shall be comprised of uniform serrated, slip resistant aluminum extrusions which interlock together lengthwise and form a 922" x.60" V-shaped gutter running the length of the planks. The interlocking mechanism will minimize deflection and not separate due to loads being applied to individual planks. The locking mechanism by design shall allow for expansion and contraction of individual planks without effecting the performance of the system.
 - 3. The system shall cause the deck planks to react together at all treads and cross walks to live load and form the appearance of a single tread system. By design, this system forms a solid, overlapping tread and riser installation.
 - 4. The nose extrusion shall allow for a 1" extruded aluminum contrasting nose piece to be flush mounted on the leading edge and shall capture the vertical riser plank in an extruded pocket. The heel extrusion shall have a .70" vertical lip at the rear of the plank to allow for placement of vertical riser plank and inhibit fluids from escaping at the rear of the tread.
 - 5. These extrusions shall be such that the attachment of seat brackets, step brackets, mid-aisle rails and all other components is accomplished without deck penetrations. No through-bolting or drilling of the aluminum tread / riser system shall be permitted.
 - 6. The system shall allow for seat and aisle reconfiguration at any time without evidence of its previous configuration.
 - 7. Entry stairs and ramps to be 2 x 12 mill finish aluminum.
 - 8. Open ends of planks to be covered with aluminum end caps, securely fastened to the plank.
 - 9. Joint Sleeves: Dual joint sleeves to be inserted at each butt joint of each load bearing aluminum plank, and to penetrate 6 inches into each plank at the joint. Joint sleeves are not required at secondary gutter locations.
- g. Guard railing: To be at all sides of bleacher, entry stairs and ramps, portals, and landings. Railing to be anodized aluminum with end plugs at ends of straight runs and/or elbows at corner. All guardrails shall be secured to angle rail risers by galvanized fasteners. Railing shall be 42" above walkways and entrances. Railing shall be 42" above any adjacent seat. Railing shall be 48 inches above top row of bleachers and ends of grandstands. Guard railing on sides and back shall include 9gauge black vinyl clad chain link fencing fastened in place with galvanized fasteners and aluminum ties.
- h. Ramps:
 - i. Slope: 1 in 12. ii. Guardrails: As required by code plus toe board.

- iii. Handrail: Ramps to have handrail extension. The handgrip portion of handrails shall not be less than 1 1/2 inches or more than 2 inches in cross-sectional dimension or the shape shall provide an equivalent gripping surface. The handgrip portion of handrails shall have a smooth surface with no sharp corners. The top of handrails and handrail extensions shall be placed not less than 34 inches or more than 38 inches above the ramp surface. Where handrails are not continuous between runs, the handrail shall extend horizontally above the landing 12 inches minimum beyond the top and bottom ramps. Ends shall be returned or shall terminate in newel posts or safety terminals.
- i. Handicap Provision:
 - i. Quantity of wheelchair spaces: Per Plans
 - ii. Sides and front of any accessible recessed pockets to be closed. Sides to have galvanized steel plate factory applied and front closure to be a series of riser boards adequate to provide complete closure.
- j. Materials/Finishes
 - i. Substructures:
 - 1. Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
 - 2. Shop connections are seal welds.
 - 3. After fabrication, all steel is hot-dipped galvanized to ASTM-A-123 specifications.
 - 4. Painted steel finish is unacceptable.
 - ii. Extruded Aluminum:
 - 1. Seat Planks, Riser Boards and Railing are extruded aluminum alloy, 6063T6 with clear anodized 204R1 coating.
 - 2. Tread planks are extruded aluminum alloy 6063-T6 mill finish
 - 3. Joint Sleeve Assembly to be inserted in flat plank to maintain true alignment in joining together two plank pieces. Extruded aluminum alloy, 6063-T, mill finish.
 - iii. Accessories:
 - 1. Channel End Caps: Aluminum alloy 6063-T6, clear anodized 204R1, AAM10C22A31, Class II.
 - 2. Hardware:
 - a. Bolts, Nuts: Hot-dipped galvanized or mechanically galvanized.
 - b. Hold-down Clip Assembly: Aluminum alloy 6005A-T6, mill finish.
 - c. Structural Hardware: Equal to or greater than hot-dipped galvanized ASTM-A307. No connections utilizing high strength bolts are classed as slip critical.
 - 3. Aisle Nose and Stair Nose: Aluminum alloy, 6063-T6, non-skid painted finish. This extrusion shall be recessed into the front floor nosing plank in order to prevent a tripping hazard, no surface mounting will be acceptable. Non-skid tape is also not an acceptable means of providing this contrast due to future maintenance upkeep.
 - iv. Fabrication:
 - 1. Design Loading:
 - 2. Per ICC 300-2012 Standard for Bleachers and Grandstands.

3. Live Load: 100 psf gross horizontal projection.
4. Lateral Sway Load: 24 plf seat plank.
5. Perpendicular Sway Load: 10 plf seat plank.
6. Live Load of Seat and Tread Planks: 120 plf.
7. Guardrail: Per IBC/ICC Building Code.
8. Wind load: 30 psf.

- A. All manufactured connections shall be shop-welded.
 - i. Manufactured by certified welders conforming to AWS Standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All work performed by technicians experienced in bleacher seating installation.
- B. Project as per approved shop drawings.

3.2 FIELD QUALITY CONTROL

- A. Foundation: Footings for the grandstand shall provide sufficient bearing area at bottom to support all loads of the grandstand. Depth and design of footings shall be determined by Owner supplied soil test. Hot-dipped galvanized anchor bolts shall be secured in the concrete footings. Concrete shall attain a working strength of 3,000 psi.

3.3 CLEAN-UP

- A. Clean up all debris caused by Work of this Section.

END OF SECTION 13 34 16

SECTION 13 34 16.19 - GRANDSTAND PRESS BOX

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. Steel-supported Press Box with camera platform.

1.2 RELATED WORK

- A. Section 13 34 16 - Pre-engineered Aluminum Bleachers
- B. Section 07 41 13 – Metal Wall Panels
- C. Division 26 - Electrical

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
- B. Shop Drawings:
 - 1. Complete shop drawings for the Architect's review for type, location, quantity, and details of steel and aluminum components required for project.
 - 2. Unit layout for Owner's approval.
 - 3. Design Calculations:
 - a. All structural elements and connections shall be designed by the Contractor.
 - b. Design calculations shall be submitted prior to or with the shop drawings.
 - c. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
 - d. Shop drawings containing connections for which calculations have not been received will be returned unchecked as an incomplete submittal.
 - e. Design Calculations will be retained for the Architect's file and will not be approved or returned.
- C. Samples: Include color charts showing manufacturer's full range of colors for Architect's selection

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturers must have ten (10) years' experience in the manufacture of bleachers and permanent grandstands and press boxes; welders must be AWS certified; manufacturing capability according to various code compliances.
- B. Installer Qualifications: Experienced in the proper installation of grandstands and press boxes.
- C. Source Quality Control: Mill Test Certification.

- D. Engineer's Qualifications: The permanent grandstands and press box shall be designed by and all drawings shall be sealed by a Registered Professional Engineer licensed in the State of Texas.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the permanent grandstands and press box indicated, described, or implied.
- B. As a performance specification, the criteria for the solution of structurally sound permanent press box indicated on the Drawings or specified herein are for the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the permanent press box are totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design, the decision of the Architect will take precedence.

1.4 DESIGN CRITERIA

- A. All electric components shall be UL listed, and in accordance with the current edition of the National Electric Code.
- B. Independently support and connect the press box structure to rear of bleacher specified in Section 13 34 16.
- C. Design Loads:
- | | | |
|----|------------|---|
| 1. | Live Load: | 100 psf floor
30 psf roof (local code governs) |
| 2. | Wind: | 30 psf on vertical surfaces |

1.5 WARRANTY

- A. Warrant the Work specified herein against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship for a period of two (2) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer of press box shall be same manufacturer providing grandstands and bleachers as specified in Section 13 34 16.
- A. Specifications are based on named manufacturer. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
1. Pre-Engineered Aluminum Bleachers & Press Box Manufacturers:
 - a. Sturdisteel Co., Waco, Texas
 - b. Southern Bleacher Co., Graham, Texas
 - c. Steel Stadiums, Graham, Texas

2.2 PRESS BOX WITH METAL STRUCTURE

- A. Product Description: Type II Construction
1. Press Box Support Structure: Independently supported but connected to rear of grandstand.
 2. Press Box Dimensions: as shown on drawings
 3. Press Box shall be of open construction, allowing inspection of electrical wiring, switches and other components without destructive disassembly.
- B. Materials/Finishes
1. Press Box Support Structure:
 - a. Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
 - b. Shop connections shall be seal welds.
 - c. After fabrication, all steel shall be hot-dipped galvanized to ASTM A123 specifications.
 2. Press Box:
 - a. Floor:
 - 1) Main support: galvanized steel floor frame sized to support structure and metal belly pan for support of insulation.
 - 2) Floor: INTERLOCK Aluminum Decking System, extruded aluminum alloy 6063-T6, mill finish. Attach Decking System to steel floor frame with mechanical fasteners at end of plank and at intermediate supports. Tongue & Groove or Standard extrusion is not acceptable.
 - 3) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation R-11, 3-1/2 inches thick. Batt or roll as manufactured by Johns Manville, or equal.
 - b. Wall Structure:

- 1) 4 inch by 4 inch by 11 gauge square tubing with maximum span of 14 feet on front wall and maximum span of 6 feet on back wall and 4 inch by 2-1/2 inch by 14 gauge steel "cees" with maximum spacing of 5 feet for all walls with siding. Spans greater than these require engineered calculations for design.
 - 2) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation R-11, 3-1/2 inches thick. Batt or roll as manufactured by Johns Manville or equal.
 - 3) Interior Finish:
 - a) 1/2-inch vinyl coated gypsum panels, Gold Bond vinylsurfaced Durasan- Harvest Cotton.
 - b) Cove Base: Vinyl 4 inches by 0.080 equal to PRO CB-35 Nubian.
 - 4) Exterior Metal Wall Panel Finish:
 - a) 24-gauge prefinished HR-16 Panel as manufactured by Berridge, Kynar 500® Color - Custom color as selected by Architect or approved equal.
 - b) Paint fasteners the same color as exterior paneling.
 - c) Provide Rubber Closure Detail HR-7 by Berridge.
 - d) Provide 5/8" thickness exterior grade plywood sheathing, with minimum 30# felt or Berridge-approved Peel & Stick waterproofing membrane.
 - e) Refer to Berridge HR-16 Panel Installation Details HR-6 Panel End Lap Detail, HR-10 Eave Detail, Solid Sheathing, ~~HR-20 Gable Detail Solid Sheathing~~, HR-31 Fascia/Soffit Detail Solid Sheathing, HR-50 Header Detail Solid Sheathing, HR-54 Sill Detail Solid Sheathing, HR-62 Outside Corner Detail, Solid Sheathing, and associated Berridge details required for a sound and watertight installation.
- c. Roof Structure:
- 1) 4 inch by 4 inch by 11 gauge square tubing with maximum spacing of 6-feet on center and 4 inches by 2-1/2 inches by 14 gauge steel "cees" with maximum spacing of 2-feet on center.
 - 2) Roof: Standing Seam Metal Roof Panels, "Double Lock Seam" by Berridge Metals; Color, Custom color as selected by Architect, to match concessions and dugouts.
 - 3) Insulation: Poly-encapsulated Formaldehyde-free fiberglass building insulation, R-25 (minimum) 8 inches thick. Batt or roll as manufactured by Johns Manville or equal.
 - 4) Cornice: 26-gauge steel prefinished to match metal siding.
 - 5) Ceiling: 24 inches by 24 inches by 5/8-inch acoustical ceiling tile (USG Fissured No. 560) with USG grid main tee (model No. DXL24), cross tee (model No. DXL 216), wall angle (model No. M7), wind clips and other components manufactured by USG, or equal.
- d. Exterior Door(s):
- 1) Full flush steel construction with honeycomb core. 18-gauge skin sheets. Dimensions: 3'-0" by 6'-8". Color: to match selected metal wall panel color.

- 2) Steel door frame (16 gauge) complete with 1/2-inch threshold and weather-stripping.
 - 3) Exterior Hardware: Yale 546F Exterior Trim, or equal. Handles shall be ADA accessible lever type. Keyed alike locks to Owner's master.
 - 4) Interior Hardware: Yale 2100 Exit Device, or equal. Handle shall be ADA accessible lever type.
- e. Windows:
- 1) Frame: Extruded aluminum single hung, vertical sliding unit, thermal break.
 - 2) Sash: Tilt toward inside for easy cleaning.
 - 3) Glazing: Clear tempered panes, insulated.
 - 4) Dimensions of each unit: Dependent on compartment size, refer to Drawings. At interior wall locations or structural support locations the dimension between windows shall be no greater than 6 inches.
 - 5) Finish: Electrostatically applied acrylic enamel.
- f. Work Bench:
- 1) 18-inch-wide work bench constructed of 4 inch by 2-1/2 inch by 14 gauge steel, and 3/4 inch wood. Countertops heights shall be constructed to allow wheelchair usage at all locations.
 - 2) Solid Surface countertop: Thickness: 1/2 inch. 3) Adhesive, as required by the manufacturer.
- g. Painting: Materials equal to Coronado, or equal.
- 1) Surfaces: Exterior Door(s), Door Frame(s)
 - a) Primer: Applied by Door Manufacturer.
 - b) Finish: 2 coats acrylic latex semi-gloss enamel applied by press box manufacturer.
 - 2) Surfaces: Interior Doors (if applicable)
 - a) Primer: Jones Blair Interior Exterior Oil Primer, or equal.
 - b) Finish: 2 coats acrylic latex semi-gloss enamel.
 - 3) Surfaces: Exterior Siding
 - a) Primer: Applied by Siding Manufacturer.
 - b) Finish: Applied by Siding Manufacturer.
 - c) Touchup: If applicable
 - 4) Surfaces: Wall and Roof Structure
 - a) Primer: Coronado DTM Industrial 180-11 acrylic metal primer applied after welding, or equal.
- h. Sealant: Sonneborn NP1 – Polyurethane sealant, All temperature, UV resistant, or equal.
- i. Electrical:
- 1) Submittal drawing shall indicate devices and circuitry.
 - 2) Fixtures: 2'x4' LED, white strip design as manufactured by Lithonia Lighting, or equal. Fixtures shall be located above countertop and be maximized to full length of compartment space. See Drawings.
 - 3) Wiring shall be in nonmetallic Panduit, or equal. N.E.C. breaker box shall be 100-amp surface mounted on wall with 2-inch rigid conduit stubbed out at bottom soffit of press box ready for service

- line to be connected. Wall-mounted service connection is not allowed. (See Electrical drawings for service line to Press Box).
- 4) Electrical outlet(s) installed per NEC shall be standard duty. All outlets shall be surface mounted on wall. See Electrical Drawings.
 - 5) Sound, Telephone, Clock, Field Communication: Empty double outlet boxes per N.E.C. with 3/4-inch conduit stubbed out bottom of Press Box for use of Owner. Outlet boxes to be flush mounted into wall. Any wiring completed on-site will be the responsibility of such contractor for inspections. Quantity. Four (4). See Technology Drawings. J. Accessories:
 - 1) Communication wall jacks below scorer's table with 1/2-inch EMT conduit race through bottom of floor (3 required)
 - 2) Package Terminal Air Conditioners: Mitsubishi, Friedrich or Engineer-approved equivalent, 12,000 BTU Capacity. Condensate drain and power supply to be routed down through the press box floor assembly. Exterior Louver to be prefinished to match color and finish of the adjacent metal wall panels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Press box installation shall be handled directly by the manufacturer or by a factory certified installation subcontractor. Refer to Paragraph 2.2.B.2 above.
- B. Install press box on piers and concrete slab as shown in accordance with approved shop drawings and details and in accordance with manufacturer's instructions.
- C. Anchor framing to slabs and shim as required for proper rigid support.
- D. End caps, channel type riveted to underside of plank at all open ends.
- E. Connect seat and foot planks to the support structure by four-way adjustable clips using 5/16-inch diameter bolts.
- F. Perform Work of this Section with competent mechanics skilled in bleacher work and under the direct control and supervision of bleacher manufacturer's representative.
- G. Where erection is complete, the portion of site shall be cleared, and bleachers cleaned of all scrap and trash.
- H. Weld steel bolts to nuts at benches and footboard hold-down clips.

3.2 CLEANING

- A. Clean all surfaces according to manufacturer's recommendations.
- B. Remove all packaging and construction debris.

END OF SECTION

SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide all work for plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.
- B. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.
- C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc., required and/or necessary to completely install, clean, inspect, adjust, test, balance, and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.
- E. Unless directly specified otherwise, all noted pipe diameters herein are nominal.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, Specifications, local ordinances, industry standards, utility company regulations, and nationally accepted codes.
- B. All materials, distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused, of United States domestic manufacture, and comply with the Buy America Act, unless approved otherwise by the Engineer or Owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer to not be an inherent part of the systems as designed without additional cost to the Owner.
- E. An approved Contractor for the work under this Division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than (3) systems of comparable size and type that have served their Owners satisfactorily for not less than (3) years.

1.4 WORK INCLUDED

- A. Systems: Plumbing systems installed, and the work performed under this Division of the Specifications, shall include, but are not necessarily limited to, the following systems as noted below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically noted otherwise.
 - 1. Domestic cold water, hot water, hot water recirculation systems
 - 2. Natural gas systems
 - 3. Primary storm drainage, secondary storm drainage systems
 - 4. Sanitary drainage, waste, vent systems
- B. Contract quality control including workmanship, manufacturer's instructions, mock-ups, and demonstrations.
 - 1. Executing Mock-ups:
 - a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals, and finishes.
 - b. Do not proceed with any work involving a mock-up until the related mock-up has been approved in writing.
 - c. Acceptable mock-ups in place shall be retained in the completed work.
 - d. Perform tests and submit results as specified.
 - 2. Scheduling Mock-ups: Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer for:
 - a. Rough-in
 - b. Finish with all appurtenances in place
 - c. Insulation installed
 - d. Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

- A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and Specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.
- B. Provide all rigging required for complete installation and furnish Drawings showing necessary points of support, reactions, and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.
- C. Become thoroughly acquainted with the work involved; obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this Division necessary for the proper installation of their Contracts. Confer with other Contractors for finish adjacent to work of this Section and

arrange to have visible portions of the work (e.g., access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architect.

- D. Transmit to trades doing work of other Sections all information required for work to be provided under their respective Sections (e.g., freshwater connections, foundations, electric wiring, access doors, etc.) in ample time for installation.
- E. Where disagreements occur between the Plans and the Specifications, or within either document itself, the item or arrangement of better quality, greater quantity, or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this Division with all other Divisions to ensure that all components of plumbing and fire protection systems will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the plumbing and fire protection systems' components.
- C. Make all plumbing and fire protection connections to all equipment furnished by this Division and as required by any other Division.
- D. Electrical wiring, control equipment, and motor starters indicated on the electrical Drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the plumbing trades, either in these Specifications or on the plumbing Drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical Drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these Specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with plumbing equipment shall have overload protection in all phases. It shall be the responsibility of each Subcontractor furnishing motors and devices to advise electrical Contractor of exact function of systems to assure proper type of starter with correct number of auxiliary contacts for proper operation of the system.
- F. The plumbing trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner because of lack of such coordination.
- G. The design of the electrical system(s) is based on the plumbing equipment specified and scheduled on the Drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the plumbing trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems shall be furnished and installed under Division 26. Coordinate locations with electrical Contractor.

1.7 DRAWINGS

- A. The Drawings are schematic in nature but shows the various components of the system(s) approximately to scale and attempts to indicate how they are to be integrated with other parts of the building. Contractor shall determine exact locations by review of equipment manufacturer's data, jobsite measurements, checking the requirements of other trades, and reviewing all Contract Documents. The size of the plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed and approved manufacturers shall be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The Drawings are not intended to show exact locations of pipes and ducts, nor to indicate all offsets, fittings, and supports, but rather to indicate approximate layout.
- B. The mechanical, electrical, plumbing, and fire protection Drawings are necessarily diagrammatic in nature and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances, structural conditions, and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases, suspended ceilings, soffits, finished portions of the building, etc., unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing, and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system(s) involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement, and extent of equipment, devices, and other appurtenances related to the installation of the work shown on the Drawings are approximate. The Contractor shall not scale Drawings; rather, the Contractor shall refer to the Architect Drawings for exact dimensions of building components. Should a conflict exist between the Architect and Engineer Drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. The Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in these Specifications and the procedures covered by these Specifications have been selected as a standard because of quality, particular

suitability, or record of satisfactory performance. Refer to Division 01 Specification for additional requirements.

- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cutsheets, performance and test data, and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who, in their judgement, is unsuitable for use on the Project and that decision shall be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request, identify the product, fabrication method, or installation method to be replaced by the substitution; include related Specifications Section(s), Drawing(s), and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate with each request, the following information:
 - 1. Product data, drawings, and descriptions of products, fabrication methods, and installation procedures.
 - 2. Samples where applicable or requested.
 - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effect where applicable.
 - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and construction, to be performed by the Owner and separator Contractors that will become necessary to accommodate the proposed substitution.
 - 5. A statement indicating the effect the substitution will have on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - 6. Cost information, including a proposal of the net change, if any, in the Contract Sum.
 - 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 - 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including the Architect and Engineer's redesign and evaluation costs, resulting from the use of the proposed substitution.

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

1.9 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each Specifications Section.
- B. Coordination drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the ductwork and piping as well as the major mechanical, plumbing, and fire protection equipment are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at one-quarter (0.25) inch scale or larger shop drawings per building area. Provide larger scale at locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Shop drawings shall be dimensioned with dimensions to be referenced from column lines.
- C. Shop drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal shall be included in the Operation and Maintenance (O & M) manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in the comments section of the Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and shall be required to furnish product(s) named in the Specifications and/or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that the required correction(s) noted on the Engineer's Submittal Cover Letter have been received and complied with by the manufacturer(s). If equipment onsite is not in compliance with the correction(s) noted, then the Contractor shall be responsible for the cost of removing and replacing the equipment.
- D. Materials and equipment which are purchased or installed without submittal review and approval will be removed and replaced with specified equipment at the Contractor's expense.
- E. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc., shall be obtained prior to equipment being submitted to the Engineer.

- G. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to which item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc., of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 – General Requirements and each Specification Section.

1.11 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the plumbing or fire protection system components within the available space as indicated on the Drawings, the Contractor shall prepare a sketch to the minimum one-eighth (0.125) inch scale clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the Contract Documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials onsite in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage by storing in original packaging.
- C. Do not deliver items to jobsite before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.13 GENERAL ELECTRIC REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices, and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. The Contractor shall notify the Architect/Engineer fourteen (14) days in advance in writing before bids are due if it is necessary to adjust the horsepower of any motors or modify any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.14 ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

- A. Plumbing equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277 volt, 120 volt, 24 volt, etc.).
- C. During the submittal process, any proposed deviations from the specified equipment in the Contract Documents shall be clearly indicated on the Plumbing submittal(s). Voltages shall match that of the specified equipment in the Contract Documents; however, if the submitted equipment ampacity, horsepower, etc., differs from the specified equipment, then the Contractor shall coordinate any changes required for the submitted equipment's electrical characteristics with the Electrical Contractor at no additional cost to the Owner.
- D. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having the starting and running characteristics consistent with the torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of the driven equipment on the Shop Drawings.
 - 3. Contractor shall verify electrical characteristics of each motor with the Electrical Drawings.
 - 4. Motors which are shipped loose from equipment shall be set by the supplying Subcontractor.
 - 5. Alignment of motors factory-coupled to equipment and motors field-coupled to equipment shall be rechecked by the millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and rechecked again after forty-eight (48) hours of operation in designed service.
 - 6. Where possible, motors shall be factory mounted.

1.15 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. The original set of as-built drawings shall be scanned and transmitted to the Architect/Engineer in both full size bond (print) and Portable Document Format (PDF).
- C. As-Built drawings: Two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each of PDF and AutoCAD 2015 files on a compact disc (CD).
 - 1. Number of Copies: Submit one (1) set of marked-up as-built prints.

2. Number of Copies: Submit copies of as-built drawings.
 - a. Initial Submittal:
 - 1) Submit PDF of scanned as-built prints and one (1) set of the prints itself.
 - 2) Submit as-built AutoCAD digital files and one (1) set of the files plotted in PDF.
 - 3) Architect will indicate whether general scope of changes, additional information record, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF of scanned as-built prints and three (3) sets of prints itself.
 - 2) Submit as-built AutoCAD digital files and three (3) sets of the files plotted in PDF.
 - 3) Plot each drawing file whether changes and additional information were recorded.
- D. As-built drawings should indicate the following information at a minimum:
 1. Indicate all addendum changes to the Contract Documents.
 2. Remove Engineer's seal, name, address, and logo from the drawings.
 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
 5. Indicate all changes to construction during the construction process.
 6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
 7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
 8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
 9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
 10. Location and size of all plumbing piping above ceiling—including exact locations of valves.
 11. Indicate exact locations of all fire protection sprinkler heads and zone valves in the system.

12. Indicate exact locations of all roof-mounted equipment, wall, roof, and floor penetrations.
13. Indicate all changes with clouding around said changes.

1.16 STARTUP SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and startup of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report shall be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the Owner's personnel shall be provided following certification of the assembly.

1.17 COORDINATION OF TRADES

- A. The Contractor shall give full cooperation to other trades and shall furnish all information necessary to permit the work of all other trades to be installed satisfactorily and with the least possible interference or delay.
- B. Piping, fixtures, and plumbing equipment shall not be installed without first coordinating the installation of it with other trades. The Contractor, at their own expense, shall relocate all piping, fixtures, and plumbing equipment installed without coordination should the plumbing elements interfere with the proper installation and mounting of electrical elements, mechanical elements, technology elements, ceilings, architectural elements, and structural elements.
- C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other trades and disciplines prior to installation.
- D. In areas where more than one trade is required to utilize common openings in structural beams, joists, chases, shafts, and sleeves for the passage of conduits, raceways, piping, ductwork, and other materials, the Contractor shall coordinate the positions of all piping and plumbing equipment to be furnished under this Division so that all items, including the materials and equipment of other trades and disciplines, may be accommodated within the space available.
- E. The Contractor shall confirm that work installed under this Division does not interfere with the clearances required for finished columns, pilasters, partitions, walls, or other architectural and structural elements as shown on the Contract Documents.
- F. Work that is installed under this contract and interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract Documents.
- G. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and architectural finish conditions affecting all their work and shall arrange such work accordingly for the complete and satisfactory operation of all systems. The Contractor shall provide all offsets, fittings, valves, devices, and accessories that may be required to meet such conditions.

1.18 WARRANTY

- A. All equipment furnished and installed under this Division shall be provided with the manufacturer's standard warranty unless otherwise noted.

- B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. To “make good all defects” shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.
- B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories.
- D. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron waste piping and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

- A. Acceptable manufacturers:
 - 1. Precision Plumbing Products
 - 2. MIFAB
 - 3. Acudor
 - 4. Elmdor
 - 5. Milcor
- B. Group valves together above suspending ceilings, walls, furred spaces, etc. to minimize the number of access panels required, but with all valves freely accessible for easy maintenance and inspection. Locate all valves within 1'-0" of the access panel entry point. Minimum size requirements shall be:
 - 1. 18" X 18" for electrical-related items
 - 2. 24" X 24" for plumbing-related items
 - 3. 36" X 36" for mechanical-related items
- C. Furnish access panels of proper size to service concealed valves, cleanouts, etc. as required. Panels shall be of the proper type for the material in which they occur and are to be furnished by the Contractor but installed by the trade for the material in which the access panel is installed.
- D. Panels shall have flush doors with sixteen (16) gauge steel door; sixteen (16) gauge frame; metal wings for keying into construction; concealed hinges; screwdriver-operated stainless steel cam lock; shop-coated with one (1) coat of zinc chromate primer.

- E. Access panels shall not be installed in gypsum ceilings in public spaces.
- F. Valves above removable ceilings shall have tile clips by the Contractor for identification.

2.3 INSULATION

- A. The following system(s) shall be insulated:
 - 1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
 - 2. All domestic hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
 - 3. All horizontal storm drainage (primary) and overflow drainage (secondary) piping as well as roof drain bodies.
 - 4. All domestic water piping exposed to areas subject to freezing. Refer to Section 22 05 00, Subsection 2.4 "HEAT CABLE FOR FREEZE PROTECTION OF PIPING" for additional requirements and information.
- B. Domestic water, storm drainage, and waste drainage piping shall be insulated with four (4) lbs. density sectional fiberglass insulation. Insulation thermal conductivity k-value shall not exceed 0.24 and insulation shall have white "all service jacket" with vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with "all service jacket" three (3) inch wide tape. Insulation shall be used for exposed piping.
- C. Acceptable manufacturers:
 - 1. Johns Manville "Micro-Lok AP-T"
 - 2. Knauf "ASJ/SSL"
 - 3. Owens Corning "ASJ/SSL"
- D. Minimum requirements for piping system insulation and insulation thickness shall be as shown in the table below:

MINIMUM PIPE INSULATION			PIPE SIZE INSULATION THICKNESS (Ø)				
SYSTEM	FLUID TEMP RANGE		≤ 1"	1-1/4" – 2"	2-1/2" – 4"	5" and 6"	≥ 8"
	°C	°F	inch	inch	inch	inch	inch
Domestic cold water	ambient	ambient	0.5	1.0	1.0	1.0	-
Domestic hot water and hot water return	43.0 – 71.0	110.0 – 160.0	1.0	1.5	1.5	1.5	-
Sanitary waste above grade receiving condensate or ice machine discharge	4.5 – 15.5	40.0 – 60.0	0.5	1.0	1.0	1.5	-
Primary and secondary storm drainage	ambient	ambient	-	-	1.0	1.0	1.0

- E. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping with fiberglass insulation and with "all service jacket" protection. For exposed locations, provide one (1) inch thick rigid insulation with rigid jacket. Insulate from roof drain body, past first

elbow fitting and including all wye fittings, all the way to the change in direction at the vertical drop to below grade.

- F. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping, including the roof drain bodies, with blanket-type glass fiber bonded thermosetting resin, white vinyl vapor retarding surface, and two (2) inch wide stapling/taping tab. Insulation shall be used in concealed spaces.
- G. Insulate all horizontal sanitary waste piping receiving air-conditioning condensate or ice machine discharge with minimum one (1) to one and one-half (1.5) inch fiberglass insulation with jacket. Begin from the floor drain, including the p-trap, and insulate all the way to the change in direction at the vertical drop to below grade.
- H. At natatoriums, including the pool equipment rooms, insulate all exposed plumbing piping with a complete aluminum jacketing system. Provide color-coded, printed pipe identification label ten (10) feet on center indicating pipe system type (e.g., storm drainage, domestic water, gas, etc.).
- I. Aluminum jacketing:
 - 1. Jacket for piping shall be 0.016 inches thick, type 3105 aluminum with factory-applied one (1) mil polykraft moisture barrier.
 - 2. Covers for fittings shall be 0.024 inches thick, type 1100 aluminum to match pipe covering.
 - 3. Aluminum jacketing shall be provided for all exposed piping.
 - 4. Acceptable manufacturers:
 - a. ITW Insulation Systems Pabco/Childers
 - b. RPR Products

2.4 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.
- B. Roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.
- C. All vent piping shall be offset above ceilings or in attic spaces as required to penetrate roofs on the least-visible side(s) of the building.

2.5 FLOOR, WALL, AND CEILING PLATES

- A. Furnish and install heavy gauge, chromium-plated, steel wall and ceiling plates on all exposed pipes in finished areas where piping passes through walls, ceilings, etc.
- B. Plates shall be of the type that will remain permanently in position and, where pipes are insulated, they shall be of the size necessary to cover insulated piping.

2.6 DRAIN PAN

- A. Acceptable manufacturers:
 - 1. DiversiTech

2. Killarney Metals
 3. Riverside Sheet Metal
- B. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan under all above grade plumbing piping in the electrical rooms, MDF rooms, and IDF rooms.
 - C. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan for water heaters.
 - D. Drain pan shall have at least two (2) inches in depth and shall extend at least six (6) inches beyond the plumbing pipe or equipment.
 - E. Drain pan shall be installed at least six (6) feet above electrical panels and electrical gear for accessibility and maintenance clearances and shall be installed within six (6) inches below the plumbing pipe or equipment.
 - F. Provide steel strut channels and hangers for drain pan support.

2.7 TRACER WIRE

- A. All trace wire and trace wire components shall be domestically manufactured in the United States of America.
- B. All trace wire shall have HDPE insulation intended for direct bury and color-coded per APWA standards for the specific utility being marked.
- C. All trace wire shall be provided for underground, non-metallic system mains four (4) inches and larger.
 1. Trace wire shall be installed in the trench on top of the underground, non-metallic piping and then attached to a metal pipe above slab at the end of the run. The wire under Division 22 scope shall extend a maximum of five (5) feet outside the building exterior to an access point.
 - a. Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.
- D. Acceptable manufacturers:
 1. Copperhead Industries
- E. Trace wire (copper-clad steel):
 1. Open trench installation: direct burial 12AWG, solid steel core, soft drawn tracer wire with 250 lbs. average tensile break load, thirty (30) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 "TRACER WIRE EXECUTION" for additional requirements and information. Provide Copperhead Industries "1230-SF" or an equal, accepted manufacturer.
 2. Directional bore or jacketed installation: direct burial 12AWG, solid steel core, hard drawn, extra high strength, horizontal directional drill tracer wire with 1,150 lbs. average tensile break load, forty-five (45) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 "TRACER WIRE EXECUTION" for additional requirements and

information. Provide Copperhead Industries "1245-HS" or an equal, accepted manufacturer.

F. Connectors (copper-clad steel):

1. Splices along the continuous run of trace wire for repair of a wire break or replacement of a filed segment of wire shall use 3M "Direct Bury Splice Kits" or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting two or more wires, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.
2. Branch connections for laterals, turnouts, services, and appurtenances shall use King Innovation "DryConn" Waterproof Direct-Bury Lug Connectors (Aqua) or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting one or two wires to the main trace wire without cutting the main trace wire, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.
 - a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the resulting tone continues for that part of the associated segment of the underground system.
3. Non-locking, friction fit, twist-on, and taped connectors shall not be acceptable. Twisting of copper wiring shall not be acceptable.

G. Termination and access (copper-clad steel):

1. Termination and access point shall be located a maximum of five (5) feet outside the building exterior. Provide Copperhead Industries "SnakePit" access point or equivalent product by alternative manufacturer that is compatible with the complete tracer wire system.
2. Terminal box shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.
3. Terminal box shall consist of tubular housing, terminal board, and removable round lid.
4. Minimum dimensions shall be five and one-half (5.5) inches diameter and eight (8) inches high. Base shall be sized to fit four (4) inch PVC Schedule 40 pipe.
5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of the construction shall be impervious to chemicals typically used for snow and ice removal as well as pavement and hardscape maintenance.
6. Housing and lid shall be designed for easy access and maintenance:
 - a. Turf and landscape areas:
 - 1) Light-duty housing with plastic lid

- b. Hardscape areas:
 - 1) Heavy-duty housing with cast iron or ductile iron lid
- c. Roadway, driveway, and parking lot applications shall not be acceptable.
- 7. Terminal board shall have nickel-plated brass terminals. Terminal quantity for necessary and complete installation of the system shall be provided as required with a minimum of four (4) spare terminals provided.
- H. Grounding (copper-clad steel):
 - 1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of twenty (20) feet of 14AWG, red, HDPE insulated, copper-clad steel wire connected to the anode (minimum 0.5 lbs.) that is specifically manufactured for such applications and shall be buried at the same elevation as the utility.
 - 2. Drive-in magnesium anode shall be Copperhead Industries "ANO-1005" (1.5 lbs.) or an equal, accepted manufacturer.

2.8 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied to the piping systems below and as applicable to the scope of work installed under this Division:
 - 1. Condensate
 - 2. Domestic water (cold, hot, hot return)
 - 3. Gas
 - 4. Heat trace
 - 5. Non-potable
 - 6. Sanitary (vent, waste)
 - 7. Storm drainage (primary, secondary)
- B. Piping identification shall be applied to all piping systems in areas of exposed construction and in areas with accessible ceilings as well as in the following locations:
 - 1. Both sides of each wall, floor, and ceiling penetration
 - 2. Connections to equipment
 - 3. Adjacent to valves and flanges
 - 4. Adjacent to piping obstructed from view
 - 5. Heat trace pipe runs at no more than ten (10) foot intervals or as required by the local code
 - 6. Straight pipe runs at no more than twenty-five (25) foot intervals
- C. Adhesive type labels shall not be acceptable, provide only "snap-around" or "snap-on" type labels.

- D. The letter size, background color, and placement of markers shall conform to the requirements of ANSI/ASME A13.1 as well as all OSHA requirements. Identify all interior exposed piping and all piping in chases or plenums with a plastic “snap-around” or “snap-on” label indicating pipe system type and direction of flow arrow. Contractor shall clean piping prior to plastic marker installation. Provide consistent manufacturer for plastic markers of each system such that marker background colors, arrows, and system description are visually identical. Each system shall be clearly identified with a minimum letter size of two and one-quarter (2.25) inches for pipe sizes up to four (4) inches and a minimum letter size of four (4) inches for pipe sizes larger than four (4) inches.
- E. Acceptable manufacturers:
 - 1. Seton Nameplate Corporation
 - 2. Brady Corporation
- F. Each valve in the Division 21 and Division 22 systems shall be tagged with an individual number stamped onto the valve’s tag. Provide identification tags on all emergency fixtures and equipment shut-off valves.
- G. Valve tags shall be brass or plastic laminate, a minimum diameter of one and one-half (1.5) inches, and shall have a brass chain with hook for securing the valve tag to the valve.
- H. Valve tags shall include “P” or “FP” lettering designation to indicate the appropriate plumbing or fire protection system, respectively. Valve tag numbering shall be consecutive for each service of the plumbing or fire protection systems.
- I. Provide a printed, compiled list or schematic drawing for each system indicating the tagged locations as well as a detailed description of the system or equipment being served.
- J. Provide one (1) copy of each list or drawing that shall be framed and mounted at the location designated by the Building Engineer. Provide an additional copy of each list which shall be included in the O & M manual.

2.9 EQUIPMENT LABELING

- A. All equipment shall be labeled; this shall include all pumps, water heaters, storage tanks, compressors, water treatment systems, utility controllers, and other similar equipment.
- B. Equipment labeling shall be completed with the following items, unless noted or specified otherwise:
 - 1. Submit schedule of equipment to be included and their designations.
 - 2. Provide nameplates with one-half (0.5) inch high letters and fastened with epoxy or screws.

PART 3 – EXECUTION

3.1 OWNER INSTRUCTION – GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use O & M manuals and actual equipment installed as the basis for instruction.

- C. At conclusion of on-site training program, the Contractor shall have Owner personnel sign written certification that they have completed training and understand equipment operation. Include copy of training certificates in final O & M manual.
- D. No retainage shall be released until the Owner has received all O & M manuals and as-built drawings as well as performed a first O & M walk.
- E. Refer to individual equipment specifications for additional training requirements.

3.2 INSTRUCTION OF OWNER PERSONNEL

- A. Prior to final inspection, the Contractor shall conduct an on-site training program to instruct the Owner's operating personnel of the operation and maintenance for the installed plumbing systems.
 - 1. Provide the training during the Owner's regular working hours.
 - 2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems with the project.
- B. Time to be allocated for on-site training program:
 - 1. Minimum of eight (8) hours dedicated instructor time
 - 2. Minimum of four (4) hours per day for two (2) days
- C. Before proceeding with the on-site training program, the Contractor shall submit the program syllabus, proposed times and dates, and other pertinent information for review and approval by means of:
 - 1. One (1) copy to the Owner
 - 2. One (1) copy to the Architect
 - 3. One (1) copy to the Engineer
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the O & M manuals as the basis of instruction. Review contents of manual in detail with personnel to explain all aspects of operation and maintenance.
- F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.
- G. Demonstrate equipment functions both individually and as part of the total, integrated system.
- H. Prepare and insert additional data into the O & M manual when the need for additional data becomes apparent during instruction and training.
- I. Submit a report within one (1) week after completion of the on-site training program that demonstrations and instructions have been satisfactorily completed. Provide time, date, and hours devoted to each demonstration and instruction with a list of personnel in attendance.
- J. At the conclusion of the on-site training program, the Contractor shall have an Owner-designated individual sign a certificate to certify that they have a proper and thorough

understanding of the demonstrated and instructed systems. By signing the certificate, the individual agrees that all demonstrations and instructions have been satisfactorily completed regarding the scope and content of the O & M manuals used in the on-site training program.

- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each O & M manual.

3.3 GENERAL REQUIREMENTS

- A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections required for a complete and satisfactory startup.
- B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed in such a manner and sequence as to avoid damage of components and as required by jobsite progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical, mechanical, technology, and architectural work. Equipment, accessories, and similar items requiring normal servicing or maintenance shall be easily accessible.
- C. The Engineer reserves the right to direct the removal of any item which, in their opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

- A. During construction, all equipment shall be properly protected against damage, defacing, and freezing with manufacturer supplied or recommended shipping cartons, plastic sheeting, shipping covers, etc.
- B. All open ends of piping and equipment shall be sealed with nipples, caps, plugs, and test plugs until final connection(s) to the system is made.
- C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with protective covers at the following instances:
 - 1. Floor sink opening: Protect and cover with heavy-duty plywood or heavy-duty plastic cover by SmartGuard.
 - 2. Floor drain opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 3. Cleanout opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 4. Pipe opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 5. Fixture opening(s): Protect and cover with plastic sheet cover until final punch list.
- D. Handle and store materials in accordance with the manufacturer and supplier recommendations and in a manner preventing damage to the materials during storage and handling. Replace all damaged materials.

- E. Equipment and materials shall not be installed until the environmental conditions of the jobsite are suitable to satisfactorily protect the equipment and materials. Equipment and materials damaged or subjected to adversarial environmental conditions shall not be acceptable and shall be removed from the jobsite and replaced accordingly.
- F. Use of duct tape or other similar protection methods shall not be acceptable.

3.5 EXCAVATION, TRENCHING, AND BACKFILLING

- A. The Contractor shall perform all excavation required to install the work specified herein and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the trench banks to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for the backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and excavated areas. Any water accumulation therein shall be removed via pumping. All excavation shall be made by open cut. Tunneling and boring shall not be acceptable except underneath pavement.
- B. The bottom of the trenches shall be graded to provide uniform bearing and supports for piping, fittings, etc. on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth and tamped in twelve (12) inch layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with the specified material for a minimum of twelve (12) inches below invert elevation of the equipment or installation.
- C. The Contractor shall coordinate and provide pipe supports as required per structural Drawings for any void form system such as piping under the slab, piping exiting the building, special requirements on the backfill, etc. and as such all piping shall be supported by an approved, suspended system.
 - 1. System structure:
 - a. Provide a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.
 - b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system then remains independent from the securing hangers.
 - c. The open space of the system beneath the structural slab is designed to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.
 - 2. System components:
 - a. The system shall maintain its structural integrity in all humid environment conditions and shall have waterproof components appropriate for its intended performance. All system components, excluding all thread rods, nuts, and washers, shall be furnished by the system manufacturer.

- b. All vertical all thread rods shall have a component secured toward the top end and permanently affixed into the concrete slab to maintain the specified elevations.
 - c. System shall be installed per the manufacturer's requirements and recommendations. The Contractor shall coordinate the system installation with the structural Drawings and the manufacturer guidelines as required.
 - D. The trenches shall be backfilled with cement-stabilized sand materials approved for backfill purposes, deposited in six (6) inch layers, and tamped until the crown of the pipe is covered by a minimum of six (6) inches of material.
 - 1. Provide a sand-cement mixture producing a minimum unconfined compressive strength of one hundred (100) PSI in forty-eight (48) hours.
 - a. Design shall be based on strength specimens molded in accordance with ASTM D588 at a moisture content within three (3) percent of optimum and within four (4) hours of batching.
 - b. Determine minimum cement content from product data and statistical history. Provide no less than one and one-tenth (1.1) sacks of cement per ton of dry sand.
 - 2. Cement: Portland cement Type I conforming to ASTM C150
 - 3. Sand: Clean, durable sand meeting the grading requirements for fine aggregates of ASTM C33 and the following requirements:
 - a. Classified as SW, SP, SW-SM, SP-SM, or SM by the Unified Soil Classification System of ASTM D2487.
 - b. Deleterious materials:
 - 1) Organic impurities colored no darker than the standard color and conforming to the requirements ASTM C40.
 - 2) Lightweight pieces less than five (5) percent and conforming to the requirements of ASTM C123.
 - 3) Clay lumps less than one-half (0.5) percent and conforming to the requirements of ASTM C142.
 - c. Plasticity index of four (4) or less when tested in accordance with the requirements of ASTM D4318.
 - E. Provide a layer of sand at least six (6) inches deep under all plastic pipe installed in soil. Bell end of pipe shall be excavated to ensure that the pipe rests for its entire length upon a solid trench bottom.
 - F. The backfill under and beside the pipe shall be compacted for pipe support. The backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirements. The backfill process shall be carried out simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to ninety-five (95) percent of the

maximum density as determined by the Standard Proctor Test. Settling the backfill with water shall not be acceptable. Reopen any trenches not meeting compaction requirements or, where settlement occurs, the Contractor shall refill, compact, and restore the surface to the grade and compaction indicated as well as mounded over and smoothed off. A metallic-lined, underground warning tape shall be provided twelve (12) inches below finished grade. The warning tape shall be identifiable as to the type of line per OSHA and ANSI standard nomenclature and color.

- G. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.6 TRACER WIRE EXECUTION

- A. Trace wires shall be installed adjacent to nonmetallic underground water, gas, and main sewage lines underneath the building pad and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping systems as follows:
 - 1. Natural gas: yellow
 - 2. Sanitary sewer: green
 - 3. Storm sewer: green
 - 4. Water (potable): blue
 - 5. Water (non-potable): purple
- B. Trace wires shall be installed adjacent to nonmetallic underground gas lines at site and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping system as follows:
 - 1. Natural gas: yellow
- C. Install trace wire as required by this Section and in accordance with the local codes:
 - 1. Trace wire shall be installed in the same trench as its associated piping and shall be installed inside bored holes and casing with pipe during pipe installation. Trace wire shall be secured to the pipe as required to ensure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved, watertight connector to provide electrical continuity and shall be accessible at all trace wire access points.
 - 2. Prior to backfill, install trace wire on top of pipe and secure in place with ties or hitches at a maximum of ten (10) foot intervals and in accordance with the local jurisdiction's water utility requirements. Run trace wire continuously along the pipe and terminate at access points. Where buried splices occur, use an approved electrical splicing kit only. Provide no less than twenty-four (24) inches of coiled wire at access points for attachment to pipe-locating equipment. Each installed pipe run shall be capable of being located using the trace wire system. Protect wire insulation from damage during installation and backfill. Wire insulation that is broken, cut, or damaged shall be replaced.
 - 3. At the point of connection between existing, conductive pipes, the trace wire shall not be connected to the conductive pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved, waterproof connection to a

grounding anode and buried at the same depth as the trace wire. All such connections points shall be grounded.

4. Where existing trace wire is encountered on an existing pipe run that is being extended or tied into, the new and existing trace wire shall be connected using approved splice connectors, shall be properly grounded at the splice location(s) as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
5. Trace wire shall be laid flat and securely affixed to the pipe at the three (3) o'clock position. The wire shall be protected from damage during execution of the work. No breaks or cuts in the trace wire or trace wire insulation shall be permitted. At service saddles, placing the trace wire between the saddle and the main shall not be acceptable.
6. At all main end caps, a minimum of six (6) feet of trace wire shall be extended beyond the end of the pipe, coiled, and secured to the cap for future connections. The end of the trace wire shall be spliced to the wire of a six (6) lbs. zinc anode and buried at the same elevation as the pipe main.
7. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valve boxes near pipe intersections, e.g., tees and crosses, may require more than one access point assembly in each concrete valve box collar.
8. At the point of connection between ductile iron water mains and any dissimilar material, the trace wire shall be properly connected to the iron pipe with a "Cadweld" or approved equivalent. Trace wire welds shall be completely sealed with the use of an approved, mastic-type sealer specifically manufactured for installation at below grade. Mastic shall be applied in a thick coat at a minimum of one-quarter (0.25) inch in thickness and shall be protected from contamination by the backfill material with the use of a plastic membrane.
9. Trace wire systems shall be installed as a single continuous wire except where approved connectors are used. Looping or coiling of the wire shall not be acceptable.
10. Any damage occurring during the installation of the trace wire shall be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping or spray coating shall not be acceptable.
11. Open trench installation:
 - a. Trace wire shall be placed a minimum of eight (8) inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems, trace wire shall be laid directly upon pipe and attached at a maximum of ten (10) foot intervals with non-conductive tape. Additional attachment(s) shall be provided at offsets and fittings in the piping system. Trace wire shall be placed carefully, and great care shall be exercised during the backfill process to maintain physical integrity and position relative to piping.

- b. Splices in trace wire shall be kept to an absolute minimum. When splices are necessary, they shall be made with approved trace wire connectors as specified. Other splicing methods shall not be acceptable.
 - 12. Directional bore or jacketed installation:
 - a. Two (2) trace wires shall be provided with one (1) wire as backup.
 - b. Trace wires shall be pulled through bore hole(s) in conjunction with utility piping. Wires shall be located on opposite sides of utility piping.
 - c. Trace wire splices shall not be acceptable in drilled sections.
 - 13. Trace wires shall be interconnected at intersections of mainlines and branches utilizing a single three-way connector at each point of connection.
 - 14. A terminal box shall be provided at each building utility service entrance and shall be located above piping within five (5) feet of the point of entry into the building.
 - 15. Terminal boxes shall not be located more than one thousand (1,000) linear feet of developed pipe length apart.
 - 16. Terminal boxes shall not be installed at streets, drives, parking lots, or other areas subject to vehicular traffic.
 - 17. Terminal boxes shall not be installed at areas where access to the box is impeded.
 - 18. Terminal boxes shall be installed flush with finished grade and centered in grade-level concrete pads. Concrete pad shall be 18" X 18" minimum and shall be six (6) inches thick.
 - 19. PVC pipe risers shall be firmly attached to the bottom of the terminal box housing and extended downward to an elevation approximately twelve (12) inches above piping. Riser shall serve as a vertical conduit for guiding trace wires into the bottom of the terminal box.
 - 20. Care shall be taken to extend trace wire from utility pipe to the terminal box in an orderly and workmanlike manner as backfill is placed.
 - 21. The end of each trace wire shall be properly landed on a dedicated terminal within the terminal box(es) and securely tightened. Twelve (12) to eighteen (18) inches of excess length shall be provided for each wire within a box. Each terminal shall be clearly identified with permanent labeling. Where trace wires for multiple utilities are terminated, care shall be taken to ensure accuracy of identification at both ends.
- D. Testing:
- 1. All new trace wire installations shall be located using typical low frequency (512 hertz) line tracing equipment and witnessed by the Contractor, Engineer, and Owner's designated representative prior to acceptance of ownership.
 - 2. The verification shall be performed upon completion of rough grading and again prior to final acceptance of ownership.
 - 3. Final testing of each trace wire shall be performed after the backfill process is complete, terminal boxes have been permanently installed, and wires are

terminated. Testing shall be witnessed by the Architect, Engineer, and Owner's designated representative. It may be advisable for the Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing shall not be acceptable.

- E. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.7 CONCRETE WORK

- A. Construct curbs, pads, vaults, and similar supports for equipment where required.
- B. First floor and equipment yard: provide a minimum of six (6) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment.
- C. Second floor and above: provide a minimum of four (4) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment. Dowel pads to the structural slab.
- D. Perform all concrete work in accordance with applicable portions of the concrete sections of the code. Minimum compressive strength of concrete shall be the same as specified for slabs on grade.

3.8 CLEANING OF PIPING SYSTEMS

- A. Provide cleaning of installed piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to completely clean, purge, and circulate the system as required.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, fixtures, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements:
 - 1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line-size blow down ball valve and pipe to nearest drain. Blow down, remove, and clean strainers as frequently as necessary.
 - 2. Phase I: Initial flushing of systems. Remove loose dirt, mill scale, weld beads, rust, and other deleterious substances without damage to the system components. Open valves, drains, vents, and strainers at all system levels during flushing procedures. Flush until potable water is clear and particles larger than five (5) microns are removed. Connect dead-end supply and return headers, even if not shown on the Drawings, and provide terminal drains in bottom of pipe end caps or blind flanges. Dispose of water in an approved manner.
 - 3. Phase II: Cleaning of piping systems. Remove, without chemical or mechanical damage to any system component, adherent dirt, organic soil, hydrocarbons, soldering flux, mill varnish, piping compounds, rust, and other deleterious substances not removed by initial flushing. Flush system and replace with clean, potable water.

4. Phase III: Final flushing and rinsing of systems. Flush and rinse until potable water is clear and particles larger than five (5) microns) are removed. Operate valves to dislodge any debris in the valve body. Dispose of water in an approved manner.
5. Submit status reports upon completion of each phase of work on each system.

3.9 TESTING OF PIPING SYSTEMS

A. General:

1. Prior to insulation and concealment, all piping systems shall be subjected to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's designated representative with a minimum of forty-eight (48) hours' notice given to the parties involved.
3. All equipment, material, labor, and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected fixtures, equipment, accessories, etc. shall be isolated from the piping systems prior to testing.

B. Sanitary piping system:

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section enduring testing. All sections shall be tested with a minimum of ten (10) feet of head. In testing successive sections, at least the upper ten (10) feet of the next section shall be tested so that no piping joint in the building shall undergo a test consisting of less than ten (10) feet of head. The water shall be successfully kept in the system for at least thirty (30) minutes before inspection begins. The system shall then be made tight at all points.
2. Any point(s) of the drainage systems to be tested with air instead of water shall be performed by attaching a compressed air testing apparatus to any suitable opening and, after closing tight all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of five (5) PSI. This pressure shall be held without the introduction of additional air for a period of at least thirty (30) minutes.
3. Exterior connections shall be tested as part of the interior systems.

C. Interior water piping system:

1. Upon completion of the entire water supply system or a section of it as required, the system shall be tested prior to connection of fixtures, equipment, accessories, etc. and proved tight under a water or air pressure test of at least one hundred and fifty (150) PSI. Pressure shall hold for a period of one (1) hour without introducing additional water or air. Water used for testing shall be from a potable supply source. Defective joints or piping shall be replaced as required and all piping shall be retested as required.

D. Defective work:

1. If inspection or tests show defects, such defective work or material shall be replaced, and the inspections and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes shall not be acceptable.
- E. Additional tests:
1. Provide all additional tests such as smoke, pressure, etc. as required by the regulations or as directed by jurisdictional authorities making the inspection.
 2. Provide for any repeated test as directed by the Owner's designated representative to ensure all systems are tight as required.
 3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.10 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and performance through the range of its operations. Tests shall be made in the presence of the Architect and Engineer. Provide adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under their respective Specification Sections.
- B. Submit three (3) copies of all certifications and test reports in a timely manner ahead of work completion to allow adequate time for remedial action as required to correct deficiencies discovered in the equipment and plumbing systems.

3.11 DISINFECTION OF INTERIOR AND EXTERIOR WATER SYSTEMS

- A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.
- B. Whenever the authorities having jurisdiction do not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than fifty (50) parts per million of chlorine. The chlorinating solution shall be liquid chlorine of sodium hydrochloride solution and shall be introduced and drawn to all points in the system. The disinfecting solution shall be allowed to remain in the system for a period of eight (8) hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be thoroughly flushed from the system with clear, potable water until the residual chlorine content is no more than two-tenths (0.2) parts per million.
- C. This work shall be supervised or performed by an approved chemical testing laboratory and the results shall be sent to the Engineer or their representative for verification.

3.12 OPERATION AND MAINTENANCE MANUALS

- A. Form of manuals:
 1. Prepare data in the form of an instructional manual for use by the Owner's personnel.
 2. Format:
 - a. Size: Letter size (8.5" X 11").

- b. Text: Manufacturer's printed data or neatly typewritten equivalent.
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to be of at least the same format size as specified hereinbefore.
 - 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 - 5. Cover:
 - a. Identify each volume with the printed title, "Operating & Maintenance Instructions" and include the following elements:
 - 1) Title of project
 - 2) Identity of separate structures or facilities as applicable
 - 3) Identity of general subject matter covered in that specific volume
 - 6. Bind as specified.
- B. Content of manuals:
 - 1. Provide a neatly typewritten table of contents for each volume, arranged in a systematic order as outlined in the Specifications, and include the following elements:
 - a. The Contractor name, name of responsible principal, address, and telephone number
 - b. Each product required to be included in the table of contents and indexed appropriately to the content of the volume
 - c. Each product's associated address, telephone number, and name of:
 - 1) The Subcontractor or installer
 - 2) Maintenance Contractor, if applicable
 - 3) Identify areas of responsibilities for each party
 - 4) Local source of part supplies and part replacement
 - d. Identify each product by the product name and other identifying symbols as set forth in the Contract Documents.
 - 2. Product data:
 - a. Include sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed
 - 2) Identify data applicable to installation

- 3) Delete references to inapplicable information
 - a) All options not supplied with equipment shall be marked out or indicated in some manner.
- 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Controls and flow diagrams
 - b. Coordinate drawings with information in the Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use the Project Record Documents as maintenance drawings.
- 4. Written text, as required to supplement product data for a specific installation, shall include:
 - a. Separate headings for different procedures and organized in a consistent format
 - b. Logical sequence of instructions for each procedure
- 5. Copy each warranty, bond, and service contract issued.
 - a. Provide an information sheet for the Owner's personal indicating:
 - 1) Proper procedures in the event of failure
 - 2) Instances that might affect validity of warranties or bonds
- 6. Shop drawings, coordination drawings, and product data as specified.
- C. Sections for equipment and systems:
 - 1. Content for each unit of equipment and system as applicable:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions
 - 2) Performance curves, engineering data, and tests
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Startup, break-in, routine, and normal operating instructions
 - 2) Regulation, control, stopping, and emergency shutdown instructions
 - 3) Summer and winter operating instructions
 - 4) Special operating instructions

- c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to troubleshooting
 - 3) Disassembly, repair, and reassembly
 - 4) Alignment, adjusting, and checking
 - 5) Routine service based on operation hours
 - d. Servicing and lubrication schedule as well as a list of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by the controls manufacturer.
 - g. Installed equipment and system control diagrams by the controls manufacturer.
 - h. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include:
 - 1) Predicted life of each part subject to wear
 - 2) Items recommended to be stocked as spare parts
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. Color-coded piping diagrams of the installed equipment and systems.
 - l. Charts of valve tag numbers with location and function of each valve.
 - m. Other data as required under relevant sections of the Specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in relevant sections of the Specifications.
 - 4. Provide complete information for products specified in Division 22.
 - 5. Provide certificates of compliance as specified in each related section of the Specifications.
 - 6. Provide startup reports as specified in each related section of the Specifications.
 - 7. Provide signed receipts for spare parts and materials.
 - 8. Provide training report and certificates.
 - 9. Provide backflow preventer certification test reports.
 - 10. Provide gas piping pressure test reports.

END OF SECTION 22 05 00

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. Erico Caddy.
 - 3. PHP System.
 - 4. Anvil/Anvil Strut.
 - 5. BLINE.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - a. Provide at all system stub-ups from below grade thru ground floor slab.
 - 8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 - 12. Non-metallic pipe support: Vinyl-coated Hangers.
 - 13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
 - 14. Unless otherwise noted, galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Provide locking nuts on all rod extensions.
- C. Unless otherwise noted, galvanized steel to be used for outdoor installation.

2.3 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.
- K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.

4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.

- B. Supports for Gas Piping:
1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Supports for Cast Iron Piping:
1. Vertical Piping:
 - a. Support vertical piping and tubing at base and at each floor.
 - b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
 - c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
 2. Horizontal Piping, Suspended:
 - a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
 - b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
 - c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
 - d. An anchor or bracing to be provided on all storm drain pipe fittings.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment.
 5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
 6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 8. Support riser piping independently of connected horizontal piping.
- D. Supports for copper tubing:
1. The following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

- e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod
 - 2. Install supports for vertical copper tubing every 10 feet (3 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- E. Supports for steel piping:
 - 1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 - 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- F. Supports for stainless-steel piping:
 - 1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 - 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- G. Supports for CPVC piping:
 - 1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

- f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
- H. Supports for PEX tubing:
 1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
 - b. 3/4" and smaller: 72 inches when a continuous support channel is used.
 - c. 1" and larger: 96 inches when a continuous support channel is used.
 2. Support vertical piping and tubing at base and at each floor.
 3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
 4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.
- I. Supports for PVC piping:
 1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PVC piping every 48 inches (1200 mm).
 3. Support vertical piping and tubing at base and at each floor.
- J. Supports for PP piping:
 1. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
 4. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- K. Supports for insulated piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- L. Supports for Vertical-Piping
1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- M. Design hangers for pipe movement without disengagement of supported pipe.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- O. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.3 SUMMARY

- A. Provide a complete domestic water piping system.
- B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.
- C. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
 - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor shall ensure the installer has demonstrated experience on projects of similar size and complexity and has been trained by GF Building Flow Solutions (Uponor) or an Uponor-approved trainer.
 - 1. If PEX-a or Corzan® CPVC is used as an approved alternate for applications where metallic piping is the basis of design the manufacturer shall submit shop drawings clearly indicating that the design has been analyzed and modified, as required, to maintain required pressure and flow. Any design resulting in reduced system pressure as a result of improper PEX-a or Corzan® CPVC sizing or design shall not be permitted.
- B. Ensure materials in contact with the Corzan® CPVC piping system are compatible with Corzan® CPVC compounds per the Lubrizol “FBC System Compatibility Program” found at www.lubrizol.com/CPVC/FBC-System-Compatible-Program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.8 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

1.9 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

- A. In-Building Riser: At incoming below grade domestic water service entry for pipe sizes 4" and larger, provide a 90-degree jointless ASTM A312 304 stainless steel in-building riser by Ames Fire & Waterworks Series IBR. Lead-free, NSF approved for potable water supply, UL Listed, FM Approved, NFPA 24, AWWA C900 inlet/DIP, AWWA C606 outlet. Provide concrete thrust block at 90-degree change of direction. Provide custom length as required where standard 6'-0" length does not extend past building perimeter wall.
- B. Copper Tubing: ASTM B88, Type K.
 - 1. Fittings: ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.

2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing 6" and smaller: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints:
 - a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

- c. Appurtenances for Grooved-End Copper Tubing:
 - 1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
 - a) Victaulic
 - 2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - 3) Mechanical Couplings for Grooved-End Copper Tubing:
 - a) Copper-tube dimensions and design similar to AWWA C606.
 - b) Ferrous housing sections.
 - c) EPDM-rubber gaskets suitable for hot and cold water.
 - d) Bolts and nuts.
 - e) Minimum Pressure Rating: 300 psig.
- 3. At the Contractor's option:
 - a. Viega ProPress Copper and Cast Copper Alloy Press-Connect Fittings:
 - 1) Approved for use with copper tubing conforming to ASTM B88 or B75. When pressing onto B88 copper tube, types K, L, and M may be used. Tempers O60 and O50, known as "soft copper", are limited to nominal sizes 1/2" to 1-1/4". Temper H58, known as "hard copper", may be used with nominal sizes 1/2" to 4".
 - 2) Shall conform to ASME B16.51, ASTM B1029 & F3226, ICC AC156, IAPMO PS-117, NSF 61, and NSF 372.
 - 3) Copper alloy fittings:
 - a) Shall be zero lead silicon bronze alloy C87710 (cast) or C88700 (machined).
 - b) Shall not be bismuth bronze or yellow brass.
 - 4) Peroxidically cured EPDM elastomeric sealing element rated to 300 psi with a temperature range of 0-250 degrees (F). Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
 - 5) 420 stainless steel grip & PBT separator rings for 2-1/2" to 4" sizes.
 - 6) Press Connect fitting shall have the Viega Smart Connect feature integral to the fitting body to detect unpressed fittings during the testing process.
 - 7) Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
 - 8) Single source manufacturer. Technology and installation instructions vary between manufacturers.
 - 9) Approved manufacturer: Viega LLC (no exceptions).
 - a) Warranty: 50 years from the date of installation.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered or press-connected joints.
- B. Pipe Size 2-1/2 inches and Larger:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets or press-connected joints.

2.5 GALVANIC PROTECTION

- A. Dissimilar piping material connections shall not be made without an approved dielectric union.
- B. Dielectric Connections:
 - 1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
 - 2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.
 - 3. 1/2" to 4" Viega ProPress zero lead press-connect unions and flanges.

2.6 VALVES

- A. General
 - 1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
 - 2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.
- B. Ball Valves:
 - 1. Manufacturers:
 - a. Apollo.
 - b. Bray.
 - c. Milwaukee.
 - d. NIBCO INC.
 - e. When at the Contractor's option: Viega, LLC
 - 2. Two (2) inches and Smaller: Nibco S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
 - 3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
 - 4. Ball Valves for CPVC 2 inch to 4 inch: body material, Schedule 80 CPVC, cell class 23447 per ASTM D1784. Basis of design GF Building Flow Solutions (Uponor).
 - 5. Ball valves installed outdoors or in-ground shall have stainless steel handle.
 - 6. Viega ProPress copper press-connect ball valves: ANSI Z1157, NSF 61 & 372, two-piece, zero lead, full-port, 1/2" to 4", 300 CWP, double stem seal, EPDM sealing elements, 316 stainless steel ball & stem, reinforced PTFE seats, lockable handle, press-connect ends.
 - 7. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
 - 8. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

- C. Shut-off Valves:
 - 1. Manufacturers:
 - a. Apollo.
 - b. Milwaukee.
 - c. M&H Valve – Div. of McWane, Inc.
 - d. NIBCO INC.
 - 2. Line Shut-Off Valves 2-1/2" to 3" where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS, or approved equivalent model by Kitz, Bray, Milwaukee, or Apollo.
 - 3. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
- D. Swing Check Valves:
 - 1. Manufacturers:
 - a. Apollo.
 - b. Milwaukee.
 - c. NIBCO INC.
 - d. When at the Contractor's option: Viega, LLC
 - 2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
 - 3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.
- E. Balancing Valves (Hot Water Recirculation)
 - 1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
 - 2. Balancing valves shall be IMI Flow Design model UA Zero series (0.5 to 1.5 GPM venturi range) or approved equal by CircuitSolver, or Bell and Gossett CircuitSetter. When at the Contractor's option: Viega, LLC. Provide extended handle as required.
 - 3. Ball valves are not acceptable for balancing the hot water return system.

2.7 STRAINERS

- A. Manufacturer: Watts, Crane or approved equal. When at the Contractor's option: Viega, LLC.
- B. Two (2) inches and Smaller: Threaded (lead free) cast copper silicon alloy for 400 PSI WOG, wye pattern with 1/32 inch stainless steel perforated screen. Watts Series LF777.
- C. 2-1/2 and Larger: Class 125, flanged (lead free) cast iron strainer for 200 PSI WOG, wye pattern with 1/16-inch stainless steel perforated screen. Watts Series 77F-DI-125.
- D. Lead Free.

2.8 GAGES AND TAPS

- A. Manufacturers: For portable water system (Lead Free)
 - 1. Weiss
 - 2. Marsh

3. Weksler
 4. Dwyer
 5. Terice
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
1. Case: Stainless steel.
 2. Bourdon Tube: Phosphor bronze.
 3. Dial Size: 4-1/2 diameter.
 4. Mid-Scale Accuracy: One (1) percent.
 5. Scale: Psi.
- C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- D. Ball Valve: Brass 1/4 inch NPT for 250 psi.
- E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Do not use lead bearing solder materials.
- I. Pipe Cover and Backfilling:

1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 3. Do not use wheeled or tracked vehicles for tamping.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.
- K. Trap primer lines shall be installed with no kinks, utilizing pipe benders as recommended in the Copper Development Association, Inc. "Copper Tube Handbook – Industry Standard Guide for the Design and Installation of Copper Piping Systems" handbook, Chapter 4, Bending. Hand bending of copper tube trap primers shall be prohibited.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Insulate all domestic hot water supply and return lines.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Install water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.

- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- R. Provide check valves on discharge of all water circulating pumps.
- S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- V. Route all domestic water piping inside building in climate controlled space not subject to freezing.
- W. Do not use lead bearing solder materials.
- X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- Y. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and lock in place.
- Z. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.
- AA. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
 - 1. The manufacturer's installation instructions shall be strictly adhered to and shall follow ASTM B1029.
 - 2. Installers shall attend a manufacturer's installation training class as having been trained and qualified to join piping with press-connect fittings. On-site training and credentialing by manufacturer's representative is acceptable.
 - 3. All connections shall bear full insertion marks on the tubing.
 - 4. Special attention shall be given to the required two step pressure test.
 - a. Initial Smart Connect test for unpressed fitting detection per manufacturer's installation manual.
 - b. Following a successful Smart Connect test, the system may be pressure tested up to 600 psi maximum hydrostatically (water) and 200 psi maximum pneumatically (air) if required by local code requirements.
- BB. Lead Free.
- CC. Trap primer lines shall be installed with no kinks, utilizing pipe benders as recommended in the Copper Development Association, Inc. "Copper Tube Handbook – Industry

Standard Guide for the Design and Installation of Copper Piping Systems" handbook, Chapter 4, Bending. Hand bending of copper tube trap primers shall be prohibited.

3.5 INSTALLATION - SERVICE CONNECTIONS

- A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.
- C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.
- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.
- E. Lead Free.

3.7 INSTALLATION – PRESSURE GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install gage in piping to each inlet and outlet of water heater.
- E. Install gage in piping to each end of backflow preventer.
- F. Install gage in piping to each end of double check valves.
- G. Install gage in piping to each inlet and outlet of water softener.
- H. Install gage in piping to each inlet of water filter.
- I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.
- D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in "Permits" under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.
- E. Cleaning of piping systems:
 - 1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
 - 2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
 - 3. Phase One: Initial flushing of system.
 - a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Phase Two: Cleaning of Piping Systems:

- a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
 - b. Flush system and replace with clean water.
 - 5. Phase Three: Final flushing and rinsing:
 - a. Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 - 6. Submit status reports upon completion of each phase of work on each system.
- F. Branch Connections:
- 1. Pipe 2" and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.
- G. 2-1/2" through 36". For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.
- H. See section 220500 for additional requirements.

END OF SECTION 22 11 16

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.3 SUMMARY

- A. Provide a complete sanitary drainage system.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SANITARY SEWER PIPING, BELOW GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
 - 4. Spears
- B. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Solvent welded joints shall conform to IAPMO installation standards IS-9.
 - 3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
 - 4. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon "Super Heavy Duty" or Husky SD-4000.
 - 3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.4 VENT PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I

2. Charlotte Pipe and Foundry Co.
 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon "Heavy Duty", Tyler Wide Body or Husky HD-2000.

2.5 VENT PIPING, BELOW GRADE

- A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.
- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert as indicated on Drawings.
- B. Establish minimum separation from other services piping in accordance with code.
- C. Remove scale and dirt on inside of piping before assembly.
- D. Install with a uniform slope of not less than that required by the local plumbing code(s) with adopted amendments.
- E. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.

- F. Route pipe in straight line.
- G. Excavation:
 - 1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
 - 2. Cut the bottom of the trench or excavation to uniform grade.
 - 3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.
- H. Pipe Cover and Backfilling:
 - 1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
 - 2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
 - 3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.
 - 4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- I. Disposal of excess material:
 - 1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, install with a uniform slope of not less than that required by the local plumbing code(s) with adopted amendments. Maintain gradients.
- B. Provide and installed cleanout as required by code and local AHJ.
- C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

- D. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. At each change of direction greater than 45 Deg.
 - 3. At the base of each waste or soil stack.
 - 4. Install floor cleanouts at elevation to accommodate finished floor.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.
- E. Install a wall cleanout according to the following:
 - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
 - 2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets where pipes penetrate the slab including water closets, lavatories and EDF's.
- F. Install a exterior cleanout according to the following:
 - 1. Encase exterior cleanouts in concrete flush with grade.
 - 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.
- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- I. Install piping to maintain headroom. Do not spread piping, conserve space.
- J. Group piping whenever practical at common elevations.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- N. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Sleeve pipes passing through partitions, walls and floors.
- S. Support cast iron drainage piping at every joint.

- T. Water test all piping per code.
- U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- V. Slope all vent piping to allow for drainage.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.
- Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.5 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.6 FIELD QUALITY CONTROL

- A. Separate trenches for water lines, sanitary, storm, and gas piping.
- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
- D. Foreign pipe and fittings unacceptable.
- E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.
- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.
- G. For additions and renovations, use camera to locate routing of underslab lines.

- H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION 22 13 16

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Section Includes:
 - 1. COMMERCIAL ELECTRIC WATER HEATERS
 - 2. VACUUM RELIEF VALVES
 - 3. T & P RELIEF VALVES
 - 4. DIAPHRAGM-TYPE EXPANSION TANKS
 - 5. BACKFLOW PREVENTERS
 - 6. WATER PRESSURE REGULATING VALVES
 - 7. WATER HAMMER ARRESTORS
 - 8. THERMOSTATIC MIXING VALVES
 - 9. TEMPERATURE INSTRUMENTS

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

- A. Furnish two pump seals.

PART 2 - PRODUCTS

2.5 COMMERCIAL ELECTRIC WATER HEATERS (EWH-x)

- A. Manufacturers:
 - 1. A.O. Smith.
 - 2. Bradford White.
 - 3. American Water Heater.
 - 4. Rudd.
 - 5. State.
 - 6. Rheem.
 - 7. All electric point-of-use storage tank type water heaters provided within this project shall be the product of one manufacturer.
- B. Furnish and install a Factory-assembled and wired, electric, vertical storage domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.
- C. Water heater(s) shall have the UL seal of certification and be factory equipped with an ASME rated temperature and pressure relief valve. Water heater(s) shall be constructed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section IV Part HLW. Tank(s) shall have a coating of high temperature porcelain enamel and furnished with two (2) magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 160 psi and shall be completely assembled.
- D. Tank: Shall be insulated with 2-1/2" of rigid polyurethane foam insulation or with minimum two (2) inches glass fiber polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.
- E. Controls: Equip with diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120-volt control circuit transformer and immersion thermostat(s) with manual reset high limit control.
- F. Water heater(s) shall capable for remote monitoring, Controls, leak detection and fault alert.
- G. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 3, 5, or 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- H. Capacity:
 - 1. Storage capacity: as indicated.
 - 2. Heating element size: as indicated.

3. Number of heating elements: as indicated.
 4. Minimum recovery rate: (as indicated) gph with 100 degrees Fahrenheit temperature rise.
 5. Maximum working pressure: 160 psig.
 6. Provide integral heat traps.
 7. Provide drain pan.
- I. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.7 VACUUM RELIEF VALVES

- A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.
- B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.8 T & P RELIEF VALVES

- A. Manufacturers: Watts Industries or approved equal.
- B. Temperature and Pressure Relief:
1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
1. Watts N36 Lead Free Series.

2.10 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Bell & Gosset PT Series or approved equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Provide separate support to structure for expansion tank

2.18 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers
1. Comply with ASSE 1013.
 2. Bronze body, with bronze internal parts and stainless-steel springs.
 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
 4. Manufacturers:
 - a. Febco 825Y.

- b. Hersey FRP II
 - c. Wilkins 975.
 - d. Watts Series LF909, or approved equal
- B. Double Check Valve Assemblies:
 - 1. Comply with ASSE 1012.
 - 2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
 - 3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
 - 4. Manufacturers:
 - a. Febco 815.
 - b. Hersey BCP
 - c. Wilkins 760.
 - d. Watts Series 9D or approved equal.
- C. Dual Check Valves:
 - 1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
 - 2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
 - 3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
 - 4. Manufacturers:
 - a. Wilkins 740.
 - b. Watts Model SD-2/9BD, or approved equal
- D. Lead Free

2.25 WATER PRESSURE REGULATING VALVES

- A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
 - 1. Sizes 1/2" through 2"
 - 2. All bronze body
 - 3. 0.25% maximum weighted average lead content
 - 4. Integral stainless-steel strainer screen
 - 5. Built-in bypass check valve
 - 6. FDA approved elastomers
 - 7. Renewable seat
 - 8. Union end connection
 - 9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
 - 10. Manufactured by Wilkins Series 600XL or approved equal by Watts
- B. Large Demand Systems
 - 1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
 - 2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
 - 3. Pressure reducing pilot control
 - 4. Stainless steel disc guide, seat and bearing cover
 - 5. Stainless steel stem, nut and spring
 - 6. FDA approved Nylon reinforced Buna-N rubber diaphragm

7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
8. Cla-Val Company Series 90 or approved equal by Watts

2.26 WATER HAMMER ARRESTORS

- A. Manufacturers: Watts Series LF15M2 (NPT solid hex brass adapter) or approved equal.
- B. ANSI A112.26.1; copper construction, lead-free, piston type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.
- D. Access Panel: Acorn Model 8292 or approved equal.

2.27 THERMOSTATIC MIXING VALVES:

- A. Manufacturers:
 1. Leonard
 2. Acorn
 3. Power
 4. Bradley
 5. Zurn/Wilkins
- B. Certified to ASSE 1017 (at water heater), ASSE 1070 (at point-of-use), and meets the anti-scald requirements of ASSE 1016.
- C. Capacity:
 1. TMV-1: ASSE 1070. Flow capacity between 0.25 GPM (minimum) and 4 GPM (maximum), 5 PSI pressure drop, lead free, mounted in piping under lavatory/sink/etc.
 - (1) Model (basis of design): Leonard 170-LF-CP
 2. TMV-2: ASSE 1017. Flow capacity up to 11 GPM (maximum), 5 PSI pressure drop, 3/4" inlets and 1" outlet, lead free. Install and locate immediately at water heater hot water 3/4" outlet.
 - (1) Model (basis of design): Leonard TM-420B-LF-DT-CP
- D. Accessories:
 1. Check valve on inlets.
 2. Volume control shut-off valve on outlet.
 3. Stem thermometer on outlet.
 4. Strainer stop checks on inlets.
 5. Wall supports as required.
- E. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.
- F. Mechanical Rooms, Central Plants, Boiler Rooms: Omit cabinet, surface mount.
- G. Lead Free.

2.28 TEMPERATURE INSTRUMENTS

- A. Manufacturer: Trerice, Marsh, Weksler, Weiss, Dwyer.

- B.** Thermometer Wells.
 - 1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
 - 2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
 - 3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
 - 4. Wells shall be sized to extend a minimum of 50% into pipe

2.29 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A.** Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A.** Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00
- B.** Install water heater with the followings.
 - 1. Maintain manufacturer's recommended clearances around and over water heaters.
 - 2. Connect natural gas piping in accordance with NFPA 54.
 - 3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.
 - 4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
 - 5. Install the following piping accessories.
 - a.** On supply:
 - (1) Thermometer well and thermometer.
 - (2) Strainer.
 - (3) Pressure gage.
 - (4) Shutoff valve.
 - (5) Diaphragm-type expansion tank
 - b.** On return:
 - (1) Thermometer well and thermometer.
 - (2) Pressure gage.
 - (3) Shutoff valve.

6. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.
 - d. Pressure reducing valve.
 7. Install discharge piping from relief valves and drain valves to nearest floor drain.
 8. Install circulator and diaphragm expansion tank on water heater.
 9. Install water heater trim and accessories furnished loose for field mounting.
 10. Install electrical devices furnished loose for field mounting.
 11. Install control wiring between water heater control panel and field mounted control devices.
 12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.
 13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.
- C. Backflow Preventers and Vacuum Breakers.
1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.
 2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.
 3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
 4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.
 5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.
 6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.
- D. Water Hammer Arrestors (Hydraulic Shock Absorbers).

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.
 2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.
 3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.
- E. Water Pressure Regulating Valves.
1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.
 2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.
 3. Installation shall allow sufficient access to and space around components for adjustments and servicing.
 4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators
- F. Install diaphragm-type expansion tank on cold water supply line.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING
- C. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 SUMMARY

- A. Provide a complete system of plumbing fixtures and trim.
- B. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

1.3 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Fixture Manufacturers:
 - 1. American Standard.
 - 2. Kohler Co.
 - 3. Zurn.

- B. Fixture Trim Manufacturers:
 - 1. Bemis
 - 2. Beneke
 - 3. Church
 - 4. Zurn Industries.
 - 5. American Standard.
- C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps. Provide as indicated on plumbing fixture schedule.
 - 1. Wall Mounted: American Standard 3351.101.020
 - 2. Or as indicated on schedules.
 - 3. Trim : (Type C)
- D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
 - 1. Wall Mounted: American Standard 3351.101.020
 - 2. Or as indicated on schedules.
 - 3. Trim : (Type C)
 - 4. Provide flush valve stem offset as required.
- E. Trim:
 - 1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, Aquavantage diaphragm type with non-hold open handle, escutcheon, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Zurn AV Series Z6000AV-HET or Z6000AV-2-HET (ADA) or or provide as indicated on plumbing fixture schedule
- F. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Bemis 1655SSCT or provide as indicated on plumbing fixture schedule.
- G. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Provide concealed flush valve support option. Jay R. Smith 200 series carriers, or equal by zurn and watts.

2.2 LAVATORIES

- A. Fixture Manufacturers:
 - 1. American Standard Plumbing.
 - 2. Kohler Co
 - 3. Zurn.
- B. Fixture Trim Manufacturers:
 - 1. T & S Brass.
 - 2. Chicago.

3. Speakman.
 4. Zurn
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.
- E. L-1, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0355.012 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
1. Trim : (Type A1)
- F. L-2, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0356.421 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, single deck hole, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
1. Trim : (Type A1)
- G. Trims:
1. Supply Fitting: ASME A112.18.1 (Type A1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago 802-VE2805-665ABCP or provide as indicated on plumbing fixture schedule.
- H. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Chrome plated 17 gage open grid P. O. plug.
 3. Removable key stops.
 4. Flexible supplies.
 5. Trap and waste insulated and offset to meet ADA compliance.
 6. Tempering valve – Power LFe480 series, Acorn, or Leonard.

- I. Floor Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs. Jay R. Smith 710 Series, or equal by Zurn and watts.

2.3 LAVATORY and SINK INSULATION KIT

- A. Manufacturers:
 1. Truebro/IPS
 2. Plumberex
 3. Zurn
- B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

2.4 FLOOR DRAINS

- A. Manufacturers:
 1. Josam Mfg.,
 2. Jay R. Smith Mfg.,
 3. Wade Spec. Products
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.5 TRAP SEAL PRIMERS

- A. Manufacturers:
 1. PPP Inc.
 2. Jay R. Smith Mfg.
 3. Siouxchief
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. (TP-2)
 1. Vacuum breaker trap primer attached to water closet flush valve, similar to Zurn model P6000-TPO.

2.6 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
 - 1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers
- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Wade Spec. Products
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- D. Floor, Outdoors (DCOTG or COTG): Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.
- E. Floor, Indoors (FCO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.

2.7 WALL HYDRANTS

- A. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Woodford.
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- B. Exterior Wall Hydrant (WH-1):

1. Woodford RB67 Series, with box enclosure, freezeless, or provide as indicated on plumbing fixture schedule.
2. ASSE 1019; Chrome, freezeless, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.
- H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

- K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.
- M. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- N. Bolt carriers to the floor.
- O. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 DRAWINGS

- A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.7 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a

complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove of the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

G. No substitutions will be considered after the Award of Contract.

1.8 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.9 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.11 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

- D. Refer to individual equipment specifications for additional training requirements.

3.2 WARRANTY NOTIFICATION PROCESS – CENTRAL PLANT EQUIPMENT:

- A. District notifies general contractor via phone and/or text of an alarm or error on central plant equipment (chiller, cooling tower, pumps, boiler), followed by a warranty work order via owner designated project management software. GC acknowledges receipt via owner designated project management software and initiates the warranty resolution process.
- B. General contractor will notify their internal warranty team to issue a formal warranty sheet indicating campus, date, time and alarm detail information.
- C. General contractor warranty representative will send via email the formal warranty sheet as an attachment to the following design and subcontracting team members:
 - 1. District construction representative (Note: GC will also upload the formal warranty sheet to owner designated project management software for warranty resolution status / progress purposes)
 - 2. Project mechanical contractor project manager
 - 3. Project controls contractor
 - 4. Project test / balance contractor
 - 5. Project Architect
 - 6. Project Design engineer project manager
 - 7. Project Commissioning Agent
 - 8. Local chiller or boiler manufacturer – depending on alarm condition.
- D. Once the warranty is resolved, a detailed description of the resolution shall be filled out on the warranty form by the subcontractor or general contractor and then resent to all notification parties on what corrective action was performed. The GC will ensure that the resolution description is also uploaded to the owner designated project management software, either as a comment or by attaching the filled-out warranty form.
- E. Warranty stays open until item is resolved.
- F. Once warranty item is resolved, warranty item is officially closed in general contractor system and in the owner designated project management software.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Baldor
 2. Marathon
 3. General Electric
 4. Weg
 5. A.O. Smith
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
1. Service Factor: 1.15
 2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEAO.
 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Insulation System: NEMA Class F.
 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
 7. Sound Power Levels: Conform to NEMA MG 1.
 8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.
- F. Single Phase Motors:
1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

2. Service Factor: 1.35.

G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:

1. Starters and motors specified as part of a packaged piece of equipment.
2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
3. Variable speed controllers for variable volume air handling units and cooling towers.

B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.

C. Provide a tabulation of matched motors and starters provided under Division 23.

D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.

E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency
1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5
5	89.5	89.5	86.5	5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	7.5	91.0	91.7	89.5
10	91.7	91.7	89.5	10	91.0	91.7	90.2
15	91.7	93.0	90.2	15	91.7	92.4	91.0
20	92.4	93.0	91.0	20	91.7	93.0	91.0
25	93.0	93.6	91.7	25	93.0	93.6	91.7
30	93.6	94.1	91.7	30	93.0	93.6	91.7

40	94.1	94.1	92.4	40	94.1	94.1	92.4
50	94.1	94.5	93.0	50	94.1	94.5	93.0
60	94.5	95.0	93.6	60	94.5	95.0	93.6
75	94.5	95.0	93.6	75	94.5	95.4	93.6
100	95.0	95.4	93.6	100	95.0	95.4	94.1
125	95.0	95.4	94.1	125	95.0	95.4	95.0
150	95.4	95.8	94.1	150	95.8	95.8	95.0
200	95.4	95.8	95.0	200	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Equipment roof curbs and support rails.
 - 6. Sleeves.
 - 7. Mechanical link seals.
 - 8. Formed steel channel and angle.
 - 9. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Carpenter & Paterson Inc.
 - 2. Flex-Weld, Inc.
 - 3. Globe Pipe Hanger Products Inc.
 - 4. Michigan Hanger Co.
 - 5. B-Line Systems
 - 6. Carpenter & Patterson Inc.
 - 7. Anvil International
 - 8. Piping Technology & Products
 - 9. Grinnell
- B. Hydronic Piping:
 - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
 5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
 6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
 7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
 8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
 9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 10. Vertical Support: galvanized Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 14. Copper Pipe Support: Copper-plated, carbon steel ring.
 15. Hydronic Piping shall not have support brackets welded to hydronic piping.
- C. Roof Mounted Hydronic Piping:
1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 HOODED CURB

- A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. The Pate Co.
 - b. Custom Curb, Inc.
 - c. Roof Products, Inc.
- E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.7 SLEEVES

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.8 MECHANICAL LINK SEALS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Thunderline Link-Seal / GPT.
 2. Innerlynx.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL AND ANGLE

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Allied Tube & Conduit Corp.
 2. B-Line Systems
 3. Midland Ross Corporation, Electrical Products Division
 4. Unistrut Corp.
- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.
- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.
- D. Structural members to be loaded within manufacturers design limitations and published data.

2.10 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete
- B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
1. Hot Water Boilers: four (4) inches.
 2. Floor Mounted Pumps: four (4) inches.
 3. Floor Mounted Water Volume Tanks: four (4) inches.
 4. Air Handling Units: six (6) inches.
 5. Water Heaters: four (4) inches.
 6. Water Softeners: four (4) inches.
 7. Air Compressor: four (4) inches.
 8. Floor Mounted Expansion Tanks: four (4) inches.
 9. Floor Mounted chemical feeder tanks: four (4) inches.
 10. Floor Mounted Fans: four (4) inches.
 11. Chillers: four (4) inches.
 12. Condensing Units: four (4) inches.
 13. Heat Pump Units: six (6) inches.
 14. Dust Collectors: four (4) inches.
 15. Plasma cutters: four (4) inches.
- C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

- A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, and partition as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall and partition floor as follows:

- a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.
- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
 1. Plastic Surfaces: Milcor Style K.
 2. Ceramic Tile Surface: Milcor Style M.
 3. Drywall Surfaces: Milcor Style DW.
 4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17" circular bases removing any loose gravel and foreign matter before setting 17" circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer's system under each 17" circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

- A. Minimum hanger rod size shall be ½".
- B. Maximum hanger rod spacing shall not exceed 10'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.
- C. For trapeze supports provide a minimum of (2) two ½" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.
- D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Vibration isolation for building mechanical systems.
- B. Related Sections:
 - 1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Mason Industries model numbers are listed for identification only.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Mason Industries
 - 2. Kinetics Noise Control
 - 3. Amber / Booth
 - 4. VMC
 - 5. Vibration Eliminator
 - 6. Vibro-Acoustics

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.
- E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.

- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.
- I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.
- J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
Executive: 30
Conference rooms: 30
Private: 35
Open-plan areas: 35
Computer/business machine areas: 40
Public circulation: 40
 - 2. Schools
Lecture and classrooms: 30
Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
Theater: 25
Stage house: 25
Trap room: 25
Orchestra pit: 25
Rehearsal rooms: 25

Teaching studios: 30
Practice rooms: 30
Ensemble rooms: 30
Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.5 QUALITY ASSURANCE

- A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the

pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall

be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS (CHILLERS AND BASE-MOUNTED PUMPS)

- A. Type SFDEJ, SFEJ, SFDCR or SFU with Control Rods CR (required): Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- B. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted

for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- E. Install Work in accordance with ASME B31.9.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE
AIR HANDLING UNITS (NOTE 2)						
FLOOR MOUNTED	SLF	0.75	-	SLF	0.75	-
TO 15 HP	SLF	1.5	-	SLF	0.75	-
20 HP & OVER						
SUSPENDED	30N	1	-	30N	1	-
UP TO 15 HP	PC30N	1.75	-	PC30N	1	-
20 HP & OVER						
HIGH PRESSURE FAN	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
SECTION (NOTE 1)	BI	2.5	RBMK	BI	1.5	RBMK
UP TO 30 HP	SLF/W			SLF/W		

40 HP & OVER	BI			BI		
CENTRIFUGAL FANS CL. I & II UP TO 54-1/2" W.D. Up to 15 HP 20-50 HP 60 HP & OVER CL. I & II 60" W.D. & OVER/ALL CL. III FANS UP TO 15 HP 20-50 HP 60 HP & OVER	SLF SLF SLF SLF/W BI SLF/W BI SLF/W BI	0.75 1.5 2.5 1.5 2.5 2.5	WF RBMK RBMK RBMK RBMK RBMK	SLF SLF SLF SLF/W BI SLF/W BI SLF/W BI	0.75 0.75 1.5 0.75 1.5 1.5	WF WF WF RBMK RBMK RBMK
AXIAL-FLOW FANS (NOTE 1) FLOOR MTD. UP TO 15 HP 20 HP & OVER SUSPENDED (NOTE 1) UP TO 15 HP 20 HP & OVER	SLF SLF 30N PC30N	0.75 1.5 1 1.75	- - - WF	SLF SLF 30N PC30N	0.75 0.75 1 1.5	- - - -
VENT (UTILITY SETS) FLOOR MTD. SUSPENDED	SLF 30N	0.75 1	- -	SLF 30N	0.75 0.75	- -
CABINET FANS, FAN SECTIONS (NOTE 1) CL. I & II UP TO 54-1/2" W.D. Up to 15 HP 20-50 HP SUSPENDED UP TO 15 HP 20 HP & OVER	SLF SLF 30N PC30N	0.75 1.5 1 1.75	- - - -	SLF SLF 30N 30N	0.75 0.75 0.75 1.75	- - - -
PUMPS FLOOR MTD. UP TO 60 HP FLOOR MTD. 75 HP AND LARGER SUSPENDED INLINE	SLF SLF PC30N	1.50 2.50 1.75	RBMK RBMK -	SLF SLF PC30N	0.75 0.75 1.75	RBMK RBMK -
REFRIGERATION UNITS RECIPROCATING COMPRESSORS RECIPROCATING COND. UNITS & CHILLERS HERMETIC CENTRIFUGALS OPEN CENTRIFUGALS ABSORPTION MACHINES	SLF SLR/IC S SLR SLF SLR/IC S	1.5 1.5 1.5 1.5 0.75	RBMK - - RBMK -	SLF SLF WSW WSW WSW	0.75 0.75 0.15 0.15 0.15	RBMK - - - -
AIR COMPRESSORS TANK TYPE (HORIZONTAL TANK)	SLF SLF	1.5 1.5	- -	SLF SLF	0.75 0.75	- -

TANK TYPE (VERTICAL TANK)						
COOLING TOWERS & CLOSED-CIRCUIT COOLERS UP TO 500 TONS OVER 500 TONS	SLR	0.75	(1)	WSW	0.15	-
	SLR	2.5	(1)	WSW	0.15	-
AIR COOLED CONDENSERS UP TO 50 TONS OVER 50 TONS	SLR	0.75	(1)	WSW	0.15	-
	SLR	1.5	(1)	WSW	0.15	-
ROOFTOP AIR CONDITIONING UNITS REQUIRING WEATHER SEAL UP TO 5000 CFM (12 TON) OVER 5000 CFM (12 TON) OTHER TYPES UP TO 25 TONS OVER 25 TONS	SLF	0.75	RSC/C	-	-	-
	SLR	1.5	MAB	-	-	-
	SLR	1.5	RSC/C	-	-	-
	SLR	1.5	MAB	-	-	-
	SLR	1.5	(1)	-	-	-
	SLR	1.5	(1)	-	-	-
BOILER (PACKAGE TYPE) ALL SIZES	SLR	0.75		WSW	0.15	-
ENGINE DRIVEN GENERATORS UP TO 60 HP 75 HP & OVER	SLR	1.5	RBMK	SLR	0.75	-
	SLR	2.5	RBMK	SLR	0.75	-

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.
2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.
- B. Related Sections:
 - 1. Section 09 91 00 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. District Standards for identification and color scheme.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
 - 5. Marking Services, INC. (MSI).
 - 6. Brimar.
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
 - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
 6. Brimar.
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
 3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.

- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

- 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
- 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

B. Plastic Tape Pipe Markers:

- 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
- 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

C. Plastic Underground Pipe Markers:

- 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
- 2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- 1. Craftmark Identification Systems.
- 2. Safety Sign Co.

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Craftmark Identification Systems.
- b. Safety Sign Co.
- c. Seton Identification Products.
- d. Almetek Industries.
- e. Marking Services, INC. (MSI).
- f. Brimar.

2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Craftmark Identification Systems.
- b. Safety Sign Co.
- c. Seton Identification Products.
- d. Almetek Industries.
- e. Marking Services, INC. (MSI).
- f. Brimar.

2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.
- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of Hydronic piping systems
 - 3. Testing, adjusting, and balancing of refrigerating systems.
 - 4. Measurement of final operating condition of HVAC systems.
 - 5. Sound measurement of equipment operating conditions.
 - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
- E. TAB Contractors:
 - 1. Engineered Air Balance
 - 2. Precision Air

1.3 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- C. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- D. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- E. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
 - a. General Information and Summary
 - b. Air Systems
 - c. Refrigerant Systems
 - d. Temperature Control Systems
 - e. Special Systems.
 - 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project.

Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
 - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
 - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC: "National Standards for Total System Balance."
 - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final

coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.

14. Proper strainer baskets are clean and in place or in normal position.
 15. Service and balancing valves are open.
 16. Re-sheave
- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
 2. Air Outlets and Inlets: +/- 5%
 3. Heating-Water Flow Rate: +/- 5%
 4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
 1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
 1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
 2. Verify sufficient inlet static pressure before making volume adjustments.
 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 - 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Balance variable-air-volume systems the same as described for constant-volume air systems.

2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove

proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig (kPa).
 - n. Refrigerant suction temperature in deg F (deg C).
 - o. Inlet steam pressure in psig (kPa).

G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).

- b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.

- d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).

- h. Final total pressure in feet of head or psig (kPa).
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

N. Vibration Test:

1. Location of points:

- a. Fan bearing, drive end
- b. Fan bearing, opposite end
- c. Motor bearing, center (when applicable)
- d. Motor bearing, drive end
- e. Motor bearing, opposite end
- f. Casing (bottom or top)
- g. Casing (side)
- h. Duct after flexible connection (discharge)
- i. Duct after flexible connection (suction)

2. Test readings:

- a. Horizontal, velocity and displacement
- b. Vertical, velocity and displacement
- c. Axial, velocity and displacement
- d. Normally acceptable readings, velocity and acceleration
- e. Unusual conditions at time of test
- f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and Flat Oval ducts and fittings.
 - 3. Double-wall rectangular ducts and fittings.
 - 4. Double-wall round and Flat Oval ducts and fittings.
 - 5. Double-wall flat oval / round / rectangular outdoor ductwork.
 - 6. Insulated Flexible Ducts
 - 7. Sheet metal materials.
 - 8. Sealants and gaskets.
 - 9. Duct coating requirement for Natatoriums.
 - 10. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 3. Division 23 Section "Duct Insulation" for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:

1. Adhesives.
2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. $\frac{1}{4}" = 1'-0"$ Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Envirotech Mechanical Systems
 - 2. Gurry Mechanical L.P.
 - 3. Letsos Company
 - 4. Mason Road Sheet Metal Inc.
 - 5. McCorvey Sheet Metal Works
 - 6. Titan Metals
 - 7. Telkin Sheetmetal, Inc.
 - 8. Tomball Sheet Metal Co.
 - 9. MLN
 - 10. Walsh & Albert
 - 11. Grant Sheet Metal
 - 12. Tennapel Sheet Metal
 - 13. McGill AirFlow LLC.
 - 14. Texas Duct Systems
 - 15. South Texas Sheet Metal
 - 16. Texas Air Duct Systems
 - 17. SEMCO Incorporated
 - 18. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Sheet Metal Connectors, Inc
- D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titan Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titan Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titan Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titan Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
 19. Linx.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Material:
1. Outer Duct: 18-gauge epoxy coated galvanized duct.
 2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.
- D. Inner Duct: 20 gauge perforated galvanized duct.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.
1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
- F. Exterior Coating / Finish.
1. Epoxy coated exterior duct.
 2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.
 3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thermaflex Type M-KE.
 - b. Atco
- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
 - a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
 - b. Maximum Velocity: 4,000 fpm.
 - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
 - d. Thermal Resistance: Minimum R-6 installed.
 - e. Maximum flexible duct length shall not exceed 5'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 DUCT COATING REQUIREMENTS FOR NATATORIUMS

A. General Coating Requirements: For any Metal Supply, Return, Outside Air, and Mixing Plenum duct including turning vanes and access doors; all surfaces shall be completely coated externally and internally prior to installation of insulation.

1. Inner liner and duct work: Amercoat PSX® 700 ETC. or prior approved equal.
 - a. Application Procedure: Adhere to all application instructions, precautions, conditions, and limitation to obtain the maximum performance. Contact PPG representative for manufacturer's recommendations.
 - b. Surface Preparation: Prior to coating, primed surface must be clean, dry, undamaged, and free of all contaminants. Remove all loose rust, dirt, grease, oil, etc. or any other contaminants.
 - c. Environmental Conditions: Surface temperatures must be at least 5°F above dewpoint to prevent condensation during application and initial dry through.

1. Air Temperature: 40°F - 120°F

2. Surface Temperature: 40°F - 120°F

3. Relative Humidity: 40% minimum

2.10 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

- A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent, or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 DUCT STORAGE / CLEANING

- A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.
- B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:
1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16-gauge Carbon-steel sheet.
 - c. Continuously welded seams and joints
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.

- f. SMACNA Leakage Class: 3.
- 4. Ducts Connected to Dishwasher Hoods:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
 - 5. Ducts Connected to Shower Return air grilles:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
 - 6. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.
 - 7. Ducts Connected to Chlorine and Acid Rooms (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.
 - 8. Ducts Connected to Fans Exhausting Welding Fumes (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 - 1. Exposed to View: No. 4 finish.
 - 2. Concealed: No. 2D finish.

- b. Continuously welded seams and joints
- c. Pressure Class: Positive or negative 3-inch wg.
- d. Minimum SMACNA Seal Class: A.
- e. SMACNA Leakage Class: 3.

E. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
- 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Elbow Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1. Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1,000 fpm or Lower: 90-degree tap.
 - b. Velocity 1,000 to 1,500 fpm: Conical tap.
 - c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Back-draft dampers.
 - 2. Combination fire-and-smoke dampers.
 - 3. Duct access doors.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Volume control dampers.
 - 7. Flexible duct connections
 - 8. Duct Taps
 - 9. Duct test holes
 - 10. Flexible duct elbow supports
- B. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Arrow United Industries
 - 2. American Warming and Ventilating
 - 3. Ruskin
 - 4. Air Balance
 - 5. NCA
 - 6. Pottorff
 - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
 - 1. Less Than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck

- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
 3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct height up to 12".
- D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12" and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.
- E. Damper Blades:
1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
 2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
 3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- G. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
 2. On insulated ducts mount quadrant regulators on 2" standoff mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
 4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- H. Actuators:
1. Maximum damper area per actuator shall be 24 square feet face area.
 2. Actuators shall be two position or modulating spring return type.
 3. Duct mounted dampers shall have actuators mounted outside of air stream.
 4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately six (6) inches wide.
 - 3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
 - 4. Install flexible connections with a minimum of one (1) inch between metal edges.
 - 5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
 - 1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

- A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.
- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 REPORTS

- A. Per NFPA 90A, all fire dampers, smoke dampers and fire/smoke dampers must be tested prior to occupancy and contractor shall provide written confirmation if the dampers are operating as required. Provide pass / fail report in excel spreadsheet. Include type of damper, damper manufacturer / model, actuator manufacturer / model, fusible link in the excel spreadsheet.
- B. Contractor to provide as-built drawings of location of all fire, smoke and fire/smoke dampers with appropriate label that matches the installation.
- C. Per NFPA 80, contractor shall test and inspect all dampers prior to one (1) year warranty period. All inspections, testing and maintenance of dampers must be documented, indicating the location of the damper, date(s) of inspection, name of inspector and deficiencies discovered. The document must have a space to indicate when and how the deficiencies were corrected. All documentation is expected to be maintained and made available for review by the AHJ.
- D. After first year, test and inspection frequency must be every 4 years.

3.3 INSTALLATION.

- A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.
- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.

- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
 - 3. Install stainless steel volume dampers in stainless steel ducts.
 - 4. Install aluminum volume dampers in natatoriums.

3.4 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Inline Fans
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.

- 1. Fan Belts: Two (2) sets for each belt-driven fan.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each fan with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
 - Unit identification as indicated within Contract Documents.
 - Serial Number.

- Model Number.
- Capacity (CFM) and static pressure (w.g.).
- Motor Horsepower.
- Fan RPM.
- Unit Power Supply: Volts / PH / Amps.
- Supply Fan Drive Type.
- Sales Order #.
- Date of unit manufactured.

PART 2 - PRODUCTS

2.1 INLINE FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Greenheck
 2. Cook
 3. Twin City
- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:

1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
2. Gravity actuated back-draft damper with adjustable counterweight. Damper shall be epoxy coated.
3. Direct drive units shall be provided with motor speed control option.
4. Companion Flanges: For inlet and outlet duct connections.
5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.2 SIDE WALL PROPELLER FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Greenheck
 2. Cook
 3. Twin City
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, fabricated steel, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Fan Drive: Motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing.
- F. Fan Drive:
1. Resiliently mounted to housing.
 2. Statically and dynamically balanced.
 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 4. Extend grease fitting to accessible location outside of unit.
 5. Service Factor Based on Fan Motor Size: 1.4.
 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 8. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.

9. Pulleys: Cast iron with split tapered bushing; dynamically balanced at factory.
10. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
11. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
12. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Accessories:

1. Long wall housing, flush exterior with OSHA guard.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weather shield Hood: Galvanized steel to match fan and accessory size with bird screen.
5. Weather shield Front Guard: Galvanized steel with expanded metal screen.
6. Direct drive units shall be provided with motor speed control option.
7. Provide factory damper mounted with damper actuator. Actuator shall be same voltage as the motor in the fan. Damper shall energize the fan through an integral end switch. Damper shall be epoxy coated.
8. Disconnect Switch: factory provided and wired disconnect switch on 120-volt motors only; non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed, and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.
- C. Install dampers in roof curb damper tray.
- D. Provide hinged curb adapter to permit access to dampers and duct connection.
- E. Install safety screen where inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Install units with clearances for service and maintenance.

- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Air devices.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Titus
 - 2. Price
 - 3. Metalaire
 - 4. Kruger
- B. Mounting:
 - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.
 - 2. "T" Bar Ceilings: Lay-in type.
 - 3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.
- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.
 - 1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".
 - 2. Shall have a fire resistance rating of 3 hours.

3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.
 4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
 5. UL listed thermal blanket insulation and mineral fiber around entire diffuser.
 6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.
- C. Install diffusers, registers, and grilles level and plumb.
- D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure

drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

- A. Refer to Drawings.

END OF SECTION 23 37 13

SECTION 23 82 39.19 - ELECTRIC UNIT HEATERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric Unit Heaters.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.3 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 2. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.
- B. Underwriters Laboratories Inc.:
 - 1. Units to be UL Listed.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.

3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of integral controls.
6. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Suspended ceiling components.
 2. Structural members to which unit heaters will be attached.
 3. Method of attaching hangers to building structure.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Access panels.
 6. Lighting fixtures.
 7. Perimeter moldings for exposed or partially exposed cabinets.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.9 WARRANTY

- A. Furnish a five (5) year manufacturer warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start-up will not be acceptable.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Reznor
 - 2. Markel
 - 3. Raywall
 - 4. Redd-i
 - 5. Qmark
- B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, controls, and accessories complying with ARI 440:
 - 1. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
 - 2. Control Voltage: 24-volt, 60 hertz
 - 3. Wall mounted adjustable thermostat.
 - 4. Location: Suspended overhead.
 - 5. Comply with UL 2021.
- C. Cabinet: 18-gauge steel with baked enamel finish, easily removed and secured access panels, insulated or double panel construction.
- D. Supply Fan: Propeller type with direct drive, dynamically balanced and mounted with rubber vibration insulators.
- E. Heat Exchanger: High mass, all steel tubular finned type, copper brazed elements.
- F. Controls: Wall mounted Thermostat with fan switch.
- G. Motor: Totally enclosed industrial rated. Motor on units to 20KW shall utilize sealed bearings. Motor on units larger than 20KW shall be 2-speed, permanent capacitor-type, continuous duty.
- H. Wiring:
 - 1. Sub-divided circuits with individual fuse protection

2. Internal 24V control transformer.
3. Heavy duty magnetic contactors.
4. Thermal cutouts on control circuit with automatic reset.
5. Low voltage thermostatic kit with fan switch.
6. Factory wired disconnect switch.
7. Performance: Provide equipment as scheduled on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Comply with safety requirements in UL 1995.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 23 82 39.19

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided they meet the requirements of the particular project and are approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each request shall provide the following
1. A specification line by line review annotated to certify compliance,
 2. The name of the manufacturer and model, material or equipment for which it is to be substituted
 3. A complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation.

The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to reject the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
1. Verify prior to submittal of Proposal that all specified items will be available intime for installation during orderly and timely progress of the work.
 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 3. The request will not be considered if the Contractor's failure to pursue the work promptly or coordinate activities properly results in the product or method not being provided.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
1. Has investigated the proposed product and determined that it meets or exceeds the quality level of specified product.
 2. The Substitution will be provide the same warranty as the specified product, except when inability to provide specified Warranty is the reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

1.3 SUMMARY

- A. All work for electrical systems as required in the project shall be properly installed and tested to perform their intended function.

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the National Electrical Code, and local codes.
- B. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.5 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system shall be installed at the proper time and fit the available space.
- B. Locate and size all openings with the work of other trades as required for the proper installation of the electrical system components.
- C. Make all electrical connections to all equipment furnished by this division and any other division.

- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.6 DRAWINGS

- A. The drawings are schematic in nature; however they show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.
- B. The Electrical Drawings are diagrammatic in character and cannot show every connection or conduit in its exact location. These details are subject to the requirements of ordinances as well as structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out to be concealed in furred chases and suspended ceilings, etc., when located in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid the crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts the systems shall be physically arranged to fit in the space available at the elevations intended and with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.7 SUBMITTALS

- A. Specification Review:
 - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.8 EXISTING CONDITIONS

- A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.
- B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.

- C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging and labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before the time of installation. Limit the shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

- A. Provide allowance in bid for the following items
 - 1. Three (3) 20A/1P circuits, each 100 feet in length from source, for use as required during construction. Include one duplex receptacle per circuit
 - 2. Three (3) light switching circuit drops, each twenty feet in length for use as required during construction. Include one 277V light switch per circuit
 - 3. Two (2) additional exit signs for use as required during construction.
 - 4. Items shall be provided with all associated labor and necessary accessories (conductor, conduit, supports, etc.) required for proper installation.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction.
- C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 OWNER INSTRUCTION

- A. Provide on-site Owner training for all new equipment.
- B. The Operation and Maintenance manuals and actual equipment installed shall be used as the basis for instruction.

- C. At the conclusion of the on-site training program require the Owner personnel to sign a written certification indicating they have completed the training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a complete system of building wire and cable for all electrical loads.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Provide stranded conductors for all wiring.
 - 2. Conductors not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductors not smaller than 16 AWG for control circuits.
 - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
 - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
 - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN-2 insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in or under any slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

- A. Where wire and cable destinations are indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Southwire
 - 2. Republic
 - 3. Alan
 - 4. Encore
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation: NFPA 70; Type THHN/THWN-2 insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

- A. **Acceptable Use:** Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.
- B. Manufacturers:
 - 1. Atkore
 - 2. Southwire
- C. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.
- D. Comply with NEC 320.
- E. Support: Provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.
- F. Provide an insulated green grounding conductor in all Type AC cable.
- G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed and abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire, cable and conduit. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing to remain wiring connections and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations or as specified.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

- C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
 - b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
 - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
 3. Tape uninsulated conductors and connectors with electrical tape rated to 150 percent of insulation rating of conductor.
 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)	
<u>System/Phase</u>	A	B	C	N	G	IG
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.

2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
 3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
 4. Color indicated is based on accepted standards. Contractor is to verify and provide colors as required by the local authority.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

- A. Limit the number of current carrying conductors per conduit to 3. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping different voltages is not allowed.
- C. Provide metal box sizes per NEC Table 314.16 (A).
- D. Provide conduit per NEC Annex C.
- E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed exposed in finished spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other "hard" (non-lay-in) ceiling types of construction.
- C. Labeling: Provide labels on all junction boxes.
1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system's wiring name.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

- A. This paragraph shall apply to buildings when a ground ring is specified.
- B. Convene minimum one (1) week prior to commencing work of this section.

- C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

- A. Convene prior to cover up of work of this section.
- B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts
 - 6. VFC
- B. Product Description:
 - 1. Material: Copper-clad steel
 - 2. Diameter: 3/4 inch
 - 3. Length: ten (10) feet

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: #2 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.3 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. ILSCO Corporation
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical
 - 7. VFC
- B. UL Listed for grounding applications.
- C. Provide "ACORN" style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.

- D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 GROUNDING BUSSES

- A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
 - 1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
 - 2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
 - 3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
 - 4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
 - 5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
 - 6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Series two (2) inch insulators.
 - 7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
 - 8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

2.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

- A. Eight (12) inch diameter concrete pipe with belled end.
- B. 24 inches long or longer to reach ground and set flush in grade.
- C. Provide cast iron cover with "GROUND" embossed on top.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.

- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

- A. Install in accordance with NEC Article 250 Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment. Route the grounding electrode conductor to, and bond to, the grounding electrode system. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.
- B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.
- E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- F. Transformers: Ground as a separately derived source.
 - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
 - 2. Size bonding jumper per NEC Table 250.66.
 - 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Concrete-Encased Electrode (NEC 250-52):
 - 1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless otherwise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.
- I. Made Electrode:
 - 1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
 - 2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
 - 3. Install grounding electrode conductor of 3/0 Copper.

- J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- K. Grounding Busses:
 - 1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
 - 2. Provide in each IDF and MDF room.
 - 3. Provide at each CATV / MATV head-end mounting board.
 - 4. Provide at each building communications rack.
 - 5. Provide at each sound reinforcement equipment rack.
- L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- M. Metal Building Frame NEC 250-52.
 - 1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
 - 2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.
- N. Ground Ring Electrode (NEC 250-52):
 - 1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.
- O. Fuel Gas Piping:
 - 1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
 - 2. Gas piping shall not be used as a grounding electrode.
- P. Engine Generator Neutral:
 - 1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
 - 2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.
- Q. Outdoor Lighting Poles:
 - 1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

- A. General Check the drawings for special grounding system or grounding requirements.
- B. Telephone and data equipment grounding connections:
 - 1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.
- C. Other Buildings Served From Common Service:
 - 1. The main building service is the source for electric service to several out buildings on site.
 - 2. Isolate neutral bus from ground at each out-building main panel.
 - 3. Provide an equipment grounding conductor in feeder to each out-building main panel.
 - 4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
 - 5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.
- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

- A. Grounding Tests:
 - 1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
 - 2. Provide written test report to document all findings, test values, work done and certification of grounding system.
 - 3. Use true-RMS meters for all voltage and current measurements.
 - 4. Test telecommunications grounding riser to verify continuity.
 - 5. Check all isolated ground receptacles for correct polarity.
 - 6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
 - 7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
 - 8. Verify continuity and isolation of audio system ground bus and grounding riser.
 - 9. Perform ground resistance and continuity testing in accordance with IEEE 142.
 - 10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

- A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
 - 1. Designated Ground Rods:
 - a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
 - b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products .
 - 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
 - 1. Furnish UL Listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
 - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
 - 4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.

- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
 - 1. Seal opening at all rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.1 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.6 COORDINATION

- A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.
- B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.
- C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.
- D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Multi Cell
 - 7. O-Z Gedney
 - 8. Raco.
 - 9. or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit
- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.

- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.
- H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
 - 1. Manufacturer:
 - a. Ocal Inc.
 - b. Perma Cote Industries
 - c. Rob-Roy Industries
 - d. or Approved equal.
- I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.
- J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
 - 1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
 - 2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.
- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
 - 1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
 - 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
 - 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
 - 4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. "Quazite" or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.2 WIREWAY

- A. Manufacturers: Same as Metal Conduit.

- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.3 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.

2.4 FLOOR BOXES

- A. UL listed for wet application, watertight cast-iron, scrub-shield compliant.
- B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
 - 1. Floor: Fully adjustable before and after pour.
 - 2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
 - 3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
 - 4. Multi Gang Floor Box: Provide a minimum of a 4-gang on grade floor box Wiremold evolution #RFB series. Or approved equal by engineer. Acceptable manufacturer equals shall be from Appleton, Carlon, Crouse-Hinds, Hubbell or FSR. Floor box shall be provided with two duplex receptacles, (1) 3/4" conduit for power and (1) 1-1/2" conduit for data. Conduits shall be routed from the floor box to the nearest full height wall and up to the accessible ceiling plenum. Provide with pull string. Data conduits shall be routed from the floor box to the wall with the AV backbox for TV and from backbox in wall to the accessible ceiling plenum no daisy chain of low voltage conduits is allowed. Refer to Architect for exact location, cover types and finish prior to installation and procurement. Refer to submitted electrical power floor plan keyed notes for specific floor box types and locations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.
- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.

- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.
- U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.
- V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- AA. Close ends and unused openings in wireway.
- BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.4 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
 - 1. Under Slab on Grade: Schedule 40 PVC.
 - 2. Outdoor Locations, Above Grade: Rigid galvanized steel.
 - 3. Wet and Damp Locations: Rigid galvanized steel.
 - 4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
 - 5. Underground:
 - a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs, parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
 - b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6" above raceway.
 - 6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
 - 7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.
- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.
- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.
- K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.
- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.6 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.8 INSTALLATION - FLOOR BOXES

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.

- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.9 ADJUSTING

- A. Adjust floor box flush with finish material.

3.10 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.
- B. Color Code: All Electrical junction boxes above ceiling shall be colored as follows.
 - 1. Yellow for 277V lighting
 - 2. Blue for 120V regular power
 - 3. Green for 120V computer power
 - 4. Brown for 277/480V equipment
 - 5. Red for emergency power

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Underground Warning Tape.
 - 3. Lockout Devices.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
 - 1. National Electrical Code, NFPA No. 70.
 - 2. NEMA standards applicable to the product provided.
 - 3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Panduit Corp.
 - 2. American Labelmark Co.
 - 3. Markal Corp.
 - 4. Calpico, Inc.
 - 5. Ideal Industries, Inc.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:
 - 1. 1/4 inch high letters for identifying individual equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.

2.3 UNDERGROUND WARNING TAPE

- A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Switchboards
 - b. Panelboards
 - c. Transformers
 - d. Service Disconnects
 - 1) Enclosed Switches
 - e. Motor Control Centers
 - f. Stand-alone Motor Controllers
 - g. Generators
 - h. Contactors
- C. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
 - 2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:
 - 1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
 - 2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
 - 3. Copy in Owner's Manual.

3.3 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

- A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data: Submit information regarding computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals **[shall] [may]** be in digital form:

1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 1. For Power Systems Analysis Software Developer.
 2. For Power System Analysis Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Arc-Flash Hazard Analysis:
 1. Provide final arc-flash hazard analysis report in hard copy and digital format.
 2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
 3. Provide library files for power system analysis software used to perform study.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Computer program shall be designed to perform arc-flash analysis.
- E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
 - 3. <Insert manufacturer's name>.
- B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.
- C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, indicating the following:
 - 1. Protective device designations, locations, and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Utility sources.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."
- F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.
- G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.
- H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.
- I. Arc-Flash Study Calculations and Output Reports:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.

7. Working distance.
 8. Incident energy.
- J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

- A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
1. Minimum Size: **6 inches (150 mm)** wide by **4 inches (100 mm)** high.
 2. Sample label submitted for review prior to printing of actual labels.
- B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
1. Equipment ID.
 2. Nominal voltage.
 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 4. Available incident energy.
 5. Working distance.
 6. Engineering report number, revision number, and issue date.
- C. Completely machine printed, no field-applied markings.
- D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.
- B. Study all operating scenarios to determine the maximum incident energy at each location.
- C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all

locations in electrical distribution system where personnel could service or examine equipment while energized.

- D. Include all three-phase medium- and low-voltage equipment locations.
- E. Calculate the limited and restricted approach boundaries for each location.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.
- G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner's attention.
 - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance or available short-circuit current at each service.
 - 3. Short-circuit current at each system bus (three phase and line to ground).
 - 4. Voltage level at each bus.
 - 5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.

6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower.
12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

- A. Apply **[one]arc-flash label on the front cover [of each section of the equipment] [and on side or rear covers with accessible live parts and hinged doors or removable plates]** for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Low voltage transformers.
 6. Panelboard.
 7. Safety switch.
 8. Fused disconnect switch.
 9. Enclosed circuit breaker.
 10. Adjustable frequency drive.
 11. Control panel.
 12. **<Insert any other equipment that could be serviced or examined while energized>.**

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION 26 05 73.19

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner will manage the commissioning process.

1.3 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.4 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.5 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.6 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the OWNER's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the OWNER and the Commissioning Agent.

- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.7 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the OWNER Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION 26 08 00

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, size, voltage ratings and current ratings.
- B. Short circuit current rating (SCCR) of equipment.
- C. U.L. Label.
- D. Electrical characteristics of equipment.
- E. Enclosure metal gauge and finish.

1.4 CLOSEOUT SUBMITTALS

- A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

- A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.
- B. Manufacturers:
 - 1. ASCO
 - 2. Square D
 - 3. GE
- C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.
- D. Lighting Contactors:
 - 1. Mechanically held, electrically operated.
 - 2. ASCO 918 or approved equal.
 - 3. Provide ASCO Accessory 47 for two-wire control of contactor. Provide time switch and photocell to control contactor.

4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
 5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
 6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.
- E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

2.2 PHOTO-ELECTRIC CONTROLS:

- A. Description:
1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
 2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
 3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
 4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.
 5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
 6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
 7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
 8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
 9. Listing: Photocell shall be listed by Underwriters Laboratories.
- B. Manufacturer: Intermatic, Paragon, Precision, Tork.

2.3 TIME CLOCKS:

- A. Manufacturer:
1. Grasslin
 2. Intermatic
 3. Paragon
 4. Precision
 5. Tork
- B. General: Provide time clocks similar to Intermatic Series T 1900 or Tork B8000 Series. Provide wiring to photocells, contactors, relays or other control points as required.

- C. Contacts: Rated for 20 amps minimum at 277 volts. Provide 1, 2, 3 or 4 pole, single or double throw, maintained or momentary contact, as required based on the time clock function and the number of branch circuits controlled. Contacts shall be horse power rated when motors are switched.
- D. Dial: Provide 24-hour dial with 15 minute intervals minimum. Dial shall permit at least 48 ON/OFF cycles per day via 96 adjustable tabs. Dial shall include a skip-a-day wheel and two day-omitting pins. Provide extra trippers and day-omitting pins if required.
- E. Special Dials: Provide special dial where indicated on drawings or in these specifications. Provide astronomic dial for time clock controlling outdoor lighting.
- F. Timing Motor: Provide heavy duty synchronous timing motor, self-starting and permanently lubricated. Motor shall be permanent magnet type for high torque and operate through and ambient temperature range of - 30 degrees Fahrenheit to + 130 degrees Fahrenheit. Motor cover shall have a viewing window to check for rotation of gears. Motor voltage shall be 120, 208, 240 or 277 volts as required.
- G. Reserve Power: Provide a spring driven reserve power drive to operate time clock for at least ten (10) hours after a power failure.
- H. Manual Bypass:
 - 1. Time clock shall include a manual ON/OFF bypass switch capable of overriding time schedule without disturbing trippers or timing sequence.
 - 2. Time clock shall be installed with a pilot-light SPST toggle switch mounted in a separate, adjacent single-gang box. Switch shall be labelled "Bypass" and shall function to turn ON circuit(s) controlled by the time clock. Switch shall be flush or surface mounted to match time clock housing.
- I. Terminals: Time clock shall have a terminal block with screws for line, load, and grounding connections with up to AWG #8 wire. Provide a removable dead-front terminal cover within the time clock case. Timing motor shall have separate, unswitched terminals.
- J. Enclosure: Provide a NEMA 1 enclosure with hasp suitable for padlock and side-hinge door for all clocks located indoors. Enclosure shall have 1/2 inch and 3/4 inch knockouts in bottom and sides. Provide NEMA 4X for those located outdoors and in wet areas.
- K. Nametag: Provide a nametag for each time clock stating load controlled; see Section 26 05 53, Electrical Identification.
- L. Listing: All time clocks shall be listed by Underwriters Laboratories and C.S.A.
- M. Manuals: Provide three sets, each consisting of operating instructions and one-line diagrams.

Specifier's Note: Edit for each Job.

2.4 DIGITAL TIME SWITCHES:

- A. Recessed in wall: WattStopper TS-400 or approved equal.
 - 1. The digital time switch shall be programmable to turn lights off after a preset time.
 - 2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.

3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.5 OCCUPANCY SENSORS:

- A. Ceiling Sensors: Require power packs
 1. UT-3000-3- Low voltage ultrasonic ceiling mounted with 2000 square foot coverage. Typical for large restroom.
DT-300- Low Voltage dual technology ceiling mounted with isolated contact. Typical for classrooms.
 2. WT-2250/2255- Typical corridor sensor- Low voltage ultrasonic ceiling mounted with 10' by 90' coverage pattern

- B. Wall Switch Sensors:
- DSW-301- Line voltage dual technology wall switch sensor for 1 circuit. Typical for large office or conference room.
 - DW-100-24- Low voltage dual technology wall switch sensor. Requires Power Pack
 - DSW-302- Line voltage dual technology wall switch sensor for 2 circuits
 - DW-311 – Line voltage dual technology wall switch sensor with 0-10V dimming
1. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
 2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
 3. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
 4. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
 5. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
 6. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
- C. Power and Auxiliary Packs:
1. BZ-150- Power pack for use with low voltage sensors when using a manual on function. 225ma
- D. High Ceiling Applications
1. HB-350B*LENS Low Voltage PIR sensor
 2. L1 Lens- 20' x 60' coverage pattern when mounted at 40'
 3. L3 Lens- 40' diameter coverage pattern when mounted at 40'
 4. L4 Lens- 60' diameter coverage pattern when mounted at 60'
- E. Passive infrared sensors:
1. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
 2. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
 3. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
 4. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.
- F. Dual technology sensors:
1. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
 2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
- G. Ultrasonic sensors:
1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$

tolerance to assure reliable performance and eliminate sensor cross-talk.
Sensors using multiple frequencies are not acceptable.

- H. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- I. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- J. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.
- K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- N. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- O. All sensors shall have UL rated, 94V-0 plastic enclosures.
- P. All occupancy sensors shall be set to maximum 30 minute time delay.
- Q. Provide minimum 5% spare sensors for owner stock of each type of occupancy sensor.

Specifier's Note: Edit for each Job.

2.6 DAYLIGHT HARVESTING – Wattstopper LightSaver® LS-301 Daylighting Sensor

- A. The photosensor shall be a self-contained, ceiling-mounted daylighting control device that detects changes in light levels and raises or lowers electrical lighting in response.
- B. The photosensor shall be a low voltage device, powered by 24 VDC voltage supplied by a power pack.
- C. The photocell shall have an extremely linear response with greater than 1% accuracy over the sensed range.
- D. The photosensor shall be capable of controlling up to 50 standard 0-10VDC electronic dimming ballasts.
- E. The photosensor shall utilize an internal photocell that measures only in the visible

spectrum and has a response curve that closely matches the photopic curve. The photocell shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.

- F. The photosensor shall provide dimming over the full range from .2 VDC to 10 VDC. When maximum dimming is required, a .2 volt output is supplied to the ballast; when full output lighting is required, a 10 volt output is supplied to the ballast.
- G. The photosensor shall use a sliding setpoint algorithm. The photosensor shall maintain the desired task level illuminance for current daylight contribution based on two setpoints, a night setpoint and a day setpoint.
- H. All setup adjustments shall be made remotely from the photosensor by means of a wireless, infrared handheld remote. All setup adjustments shall be done from the ground with no ladders required after the initial installation has been completed.
- I. The photosensor shall be controllable by a compatible handheld remote that allows an occupant to adjust the light level to their preference while enabling the automatic dimming to continue to achieve the adjusted setpoint. Any adjustment made with the handheld remote shall be easily canceled by pressing one button on the remote.
- J. The photosensor shall have a control range of 20-60 footcandles.
- K. The photosensor shall not protrude more than 0.75 inches from the ceiling and should blend in aesthetically.
- L. To ensure quality and reliability, photosensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- M. The photosensor shall have a standard five year warranty.

2.7 SPORTS LIGHTING CONTROL STATION

Specifier's Note: Edit for each Job.

- A. General: Provide pushbuttons for manual override of programmable relays designated to control the power contactors for the outdoor sports lighting at each field. Arrange pushbuttons into a single enclosure for each field.
- B. Enclosure: Enclosure shall be NEMA 4X stainless steel or polycarbonate with gasketing for outdoor wet locations.
- C. Pushbutton: Similar to Square D Class 9001-Type B, Type BW245, NEMA 4, momentary contact, RED/ON and GREEN/OFF pushbuttons with collar guard.
- D. Wiring: From each pushbutton in the Sports Lighting Control Station, provide low voltage wiring to the programmable relay cabinet.
- E. Control: BAS schedules all power contactors for outdoor sports lighting via the programmable relay system. Each sports field shall have a programmable relay assigned to the contactors for the sports lighting of that field. BAS will program automatic schedules

for the sports lighting as required. User shall be able to override automatic schedule from BAS with manual ON/OFF signals from the pushbutton Lighting Control Stations. Pushbutton signals relay cabinet, similar to a classroom light switch, and relay causes the lighting contactors to change state (OFF to ON, ON to OFF).

- F. Engraving: Provide engraved lamacore plate above each pushbutton describing the lighting it will control. Example: TENNIS COURTS; FOOTBALL-EAST POLES, FOOTBALL-WEST POLES, BASEBALL, SOFTBALL.
- G. Relays: For each pushbutton control, provide a relay in the local relay cabinet nearest the sports lighting contactors. Wire relay to the control circuits of the associated sports lighting contactors. Program BAS for both automatic scheduling of the sports lighting and to accept manual override from pushbutton Sports Lighting Control Stations.

PART 3 - EXECUTION

3.1 PHOTO-ELECTRIC CONTROL MOUNTING:

- A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.2 TIME CLOCK PROGRAMMING:

- A. Install time clock and photocell for ON by photocell at dusk, OFF by time clock at midnight, then ON by time clock at 5:00 a.m. and OFF by photocell at dawn. Program time clock ON/OFF times to other time(s) when indicated on Drawings.

3.3 INSTALLATION

- A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".
- B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.
- C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

END OF SECTION 26 09 23

SECTION 26 09 43 - DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Distributed Digital Lighting Control System: System includes
 - 1. Digital Lighting and Plug Load Controls
 - 2. Relay Panels
 - 3. Emergency Lighting Control.

1.2 RELATED SECTIONS

- A. Section 27 10 00 – Structured Cabling System
- B. Section 26 50 00 - Lighting
- C. Section 23 09 23 – Direct Digital Controls
- D. Section 23 09 93 – Sequence of Operation for HVAC Controls

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.
- B. NEMA - National Electrical Manufacturers Association
- C. FCC emission standards
- D. UL - Underwriters Laboratories, Inc. Listings
- E. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.
- F. UL 20 - General Use Switches, Plug Load Controls
- G. UL 924 - Standard for Emergency Lighting and Power Equipment
- H. ULC - Underwriter Laboratories of Canada Listings

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Lighting Control System shall accommodate the square-footage coverage requirements for each controlled area, utilizing room controllers, plug load controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.
- B. System shall conform to requirements of NFPA 70.
- C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.
- D. System shall be listed under UL sections 916 and/or 508.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets for each product to be used, including:

1. Catalog sheets and specifications.
 2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 3. Storage and handling requirements and recommendations.
 4. Installation instructions.
- C. Shop Drawings: Wiring diagrams for the various components of the System specified including:
1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on the reflected ceiling plans.
 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 4. Network riser diagram including floor and building level details. Riser shall illustrate points of connection to integrated systems and coordinate integration with mechanical and/or other trades. Network cable specification shall be included.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Closeout Submittals:
1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
 2. Operation and Maintenance Manual:
Include the following
 - a. Approved Shop Drawings and Product Data.
 - b. Sequence of Operation, identifying operation for each room or space.
 - c. Manufacturer's maintenance information.
 - d. Operation and Maintenance Data with detailed information on device programming and setup.
 - e. Startup and test reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing centralized and distributed lighting control systems with a minimum of 10 years documented experience.
- B. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.7 PRE-INSTALLATION MEETINGS

- A. Convene the meeting a minimum of two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.
- B. Review installation procedures and coordination required with related Work and the following:
1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
 2. Review the specifications for low voltage control wiring and termination.
 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 4. Discuss requirements for integration with other trades
- C. Inspect and make notes of job conditions prior to installation:

1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not install equipment until the following conditions can be maintained in spaces to receive equipment:
 1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
 2. Relative humidity: Maximum 90 percent, non-condensing.

1.10 WARRANTY

- A. Products Warranty: Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

1.11 MAINTENANCE

- A. Spare Parts:
 1. Provide 5% spares of each product listed below to be used for maintenance. Electrical Contractor shall deliver items to Owner within 30 days of substantial completion.
 - a. Room Controllers
 - b. Occupancy Sensors
 - c. Emergency Bypass controllers
 - d. Low voltage switches
 - e. Daylighting harvesting photocells

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturer: Signify (basis of design), Acuity
- B. Substitutions must meet performance requirements of this section 26 09 43.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

- A. System General: Provide a Distributed Lighting Control System complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified between the Drawing and this Specification, contact the Architect for clarification prior to proceeding.
 1. Daylit Areas: Provide daylight-responsive automatic control in all spaces (conditioned

or unconditioned) where daylight contribution is available as defined by relevant local building energy code:

- a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylight zones.
- b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
- c. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.
- d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if the system functions to turn lights back on at dimmed level, rather than turning full-on prior to dimming.

B. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.

1. Digital lighting control local network (DyNet): RS-485 based, plug-in wiring system (Cat 5e) for power and data to room devices.
2. Plenum-rated controllers for on/off and 0-10V dimming control.
3. Digital Occupancy Sensors: digitally addressable, calibrated occupancy sensors with infrared (IR) communications.
4. Digital Switches: digitally addressable pushbutton on/off, dimming, and scene switches.
5. Configuration Tools: Handheld remote for load and scene control using infrared (IR) communications to digital devices.
6. Programming and Configuration Software: Optional PC-native application capable of accessing control parameters within a room, for the local network, via a USB adapter.
7. Automatic Load Control Relays (ALCR's): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

2.3 DIGITAL LOAD CONTROLLERS (ROOM, PLUG LOAD AND FIXTURE CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without the use of software. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/potentiometers. Control units shall include the following features

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement using the default configuration capabilities, a room controller may be replaced with an off-the-shelf device with only needing to use the on-device configuration button.
3. Multiple load controllers connected together in a local network must automatically arbitrate with each other, without any specialized software
4. Service LED to indicate:
 - a. Data transmission
 - b. Output Type
 - c. Emergency Mode Active
5. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100 percent

- b. Turn off
 - c. Turn on to last level
- 7. Each load be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
- 8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
- 9. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Schedule state, normal or after-hours
 - c. Demand Response enable and disable
 - d. Room occupancy status
 - e. Total room lighting and plug loads watts
 - f. Electrical current
 - g. Total watts per controller
 - h. Total room watts/sq ft.
 - i. Force on/off all loads
- 10. UL 2043 plenum rated
- 11. Manual override and LED indication for each load
- 12. Zero cross circuitry for each load
- 13. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- 14. Dimming Room Controllers shall share the following features:
 - a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
 - b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
 - c. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - 1) Establish preset level for each load from 0-100 percent
 - 2) Set high and low trim for each load
 - 3) Initiate lamp burn in for each load of either 0, 12 or 100 hours
 - d. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
 - g. All configurations shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
- B. On/Off/0-10V Dimming KO Mount Room Controllers shall include:
 - 1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
 - 2. Optional real time current and voltage monitoring (with - M Monitoring option).
 - 3. Two RJ-45 local network ports.
 - 4. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall

- automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting
5. Dynalite product number: DDC116-UL.

2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

- A. Digital Occupancy Sensors features shall include the following:
1. Digital calibration and configuration for the following variables:
 - a. Sensitivity, 0-100 percent in 10 percent increments
 - b. Time delay, 1-30 minutes in 1 minute increments
 - c. Test mode, Five second time delay
 - d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the local network.
 3. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating a user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - e. Ultrasonic and Passive Infrared
 - f. Ultrasonic or Passive Infrared
 - g. Ultrasonic only
 - h. Passive Infrared only
 - i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. One or two RJ-45 port(s) for connection to local network.
 5. Infrared (IR) receiver to allow remote operation via handheld remote controls.
 6. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 7. Manual override of controlled loads.
 8. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- B. Multiple occupancy sensors may be installed in a room by simply connecting them to the local network. No additional configuration will be required.
- C. Dynalite product numbers: DUS804CS-UP, DUS360CR

2.5 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in multiple button configurations. Wall switches shall include the following features:
1. Infrared (IR) receiver for use with handheld remote controls.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Configuration LED on each switch that blinks to indicate data transmission.
 4. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED

- b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
 5. Programmable control functionality including:
 - a. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
 6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. Two RJ-45 ports for connection to local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the local network.
- D. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.
 1. Individual button function may be configured to Toggle, On only or Off only.
 2. Individual scenes may be locked to prevent unauthorized change.
 3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 4. Ramp rate may be adjusted for each dimmer switch.
 5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
 6. Dynalite product numbers: DS1SRA-W-DN, DS2SRA-W-DN, DS3SRA-W-DN, DS4SRA-W-DN, DS5SRA-W-DN, DS1S2ZRA-W-DN, DS1S4ZRA-W-DN, DS2S4ZRA-W-DN Available in white; compatible with wall plates with decorator opening.

2.6 DIGITAL DAYLIGHTING SENSORS

- A. Occupancy sensors shall contain integral daylighting sensors and shall work with load controllers and relay panels to provide automatic dimming daylight harvesting capabilities for any load type connected to the controller or panel.
 1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
 2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
 3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone
- B. Digital daylighting sensors shall include the following features:
 1. Sensor's internal photodiode shall only measure light waves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
 2. Sensor light level range shall be from 5-5000 LUX.
 3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
 4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
 5. For \daylight harvesting dimming, the photosensor shall provide the option, , to turn off or dim lights to a field-selectable minimum level when the daylight contribution is

sufficient

6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
9. Configuration LED status light on device that blinks to indicate data transmission.
10. One RJ-45 port for connection to DLM local network.
11. A choice of accessories to accommodate multiple mounting methods and building
12. Any load or group of loads in the room can be assigned to a daylighting zone
13. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
14. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
15. Dynalite Product Number: DUS804CS-UP, DUS360CR

2.7 HANDHELD INFRARED REMOTE CONTROL

- A. Provide an infrared remote control tool to facilitate wireless control of IR enabled devices.
- B. Features and functionality of the IR remote tool shall include but are not limited to:
 1. One-way infrared (IR) communication with IR-enabled devices within a range of approximately 30 feet.
 2. Allow user to select scenes, ramp lighting levels, or trigger tasks
- C. Dynalite Product Numbers: DTK512

2.8 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

- A. PC-native application for optional programming of detailed technician-level parameter information for all Dynalite products, including all parameters. Software shall be capable of accessing room-level parameter information locally within the room when connected via the optional PD-PCN USB programming adapter.
- B. Additional parameters exposed through this method include but are not limited to:
 1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
 2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after-hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
 3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
 4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
 5. Separate normal hours and after hours per-load buttons with modes including: Do nothing, on only, off only, on and off.
 6. Load control polarity reversal so that on events turn loads off and vice versa.
 7. Per-load DR (demand response) shed level in units of percent.
 8. Load output pulse mode in increments of 1second.
 9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered

On of switched loads in response to a dimmer.

- C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
 - 1. Device list report: All devices in a project listed by type.
 - 2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
 - 3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
 - 4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
 - 5. Device parameter report: Per-room lists of all configured parameters
 - 6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
 - 7. Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.
- D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
 - 1. Set, copy/paste an entire project site of sensor time delays.
 - 2. Set, copy/paste an entire project site of sensor sensitivity settings.
 - 3. Search based on room name and text labels.
 - 4. Filter by product type to allow parameter set by product.
 - 5. Filter by parameter value to search for product with specific configurations.
- E. WattStopper Product Number: PD-PCN USB commissioning device, System Builder application

2.9 EMERGENCY LIGHTING CONTROL DEVICES

- A. Emergency Lighting Control Units – Where required by code or specified on the drawings the following devices shall be provided
 - 1. A UL 924 listed device that monitors the switched and unswitched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. The lighting is only powered by the emergency lighting circuit. Upon normal power failure the emergency lighting circuit will close and force the emergency lighting ON to full brightness overriding any dimming control signal until normal power is restored. Bodine Product Numbers: BLCD-20B, BLCD16DIM
 - 2. A UL 1008 list device that monitors the unswitched circuit providing normal lighting in the area. The unit provides normal ON/OFF control of the emergency lighting. The lighting may be powered by either the switched normal or the unswitched emergency power. Upon normal power failure the unit will transfer from normal switched power to unswitched emergency power and force the emergency lighting ON to full brightness overriding any dimming control signal until the normal power is restored. Bodine Product Number: GTD20A

Both shall include the following features::

- 1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
- 2. Push to test button
- 3. Auxiliary contact for remote test or fire alarm system interface

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not begin installation until measurements have been verified and work areas have been properly prepared.
- B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that the required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

- A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.
- B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.
 - 1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
 - 2. Low voltage wiring topology must comply with manufacturer's specifications.
 - 3. Document all device locations and wiring on as built drawings.
- C. All line voltage connections shall be tagged to indicate circuit and switched legs.
- D. Test all devices to ensure proper communication.
- E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lit while occupied.
- F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Submit a detailed report to the Architect / Owner of post start-up activity.
- H. Tighten all panel Class I conductors from both circuit breakers and loads to torque ratings as marked on enclosure UL label.
- I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.
- J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.
- K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

- B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
 - 1. Verify Class I and II wiring connections are terminated properly by validating system performance.
 - 2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
 - 3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
 - 4. Verify that the control of each space complies with the Sequence of Operation.
 - 5. Correct any system issues and retest.
- C. Provide a report in table format with drawings or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
 - 1. Date of test or inspection.
 - 2. Loads per space, or Fixture Address identification.
 - 3. Quantity and Type of each device installed
 - 4. Reports providing each device's settings.

3.4 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete and fully functional system.
- B. The factory commissioning shall include the following services.
 - 1. Programming of all button stations,
 - 2. Configuration of all occupancy sensors and photocells.
 - 3. Verification of a complete and working system.
- C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- D. The electrical contractor shall request factory commissioning by submitting a startup request form at least (4) weeks before startup is required.
- E. Electrical contractor must schedule the lighting control factory start-up to begin at least 60 days prior to substantial completion deadline.
- F. Lighting control technician shall issue daily reports notifying of the project status, open issues, challenges, etc. at the end of each day he/ she is onsite commissioning the system. Reports shall be sent directly to EC, GC and Engineer.
- G. At the completion of the first visit of the lighting control technician, all parties shall meet onsite to walk the project and evaluate any open issues. At this meeting the schedule for owner training shall be determined.
- H. The electrical contractor shall provide at least (1) journeyman electrician, familiar with the installation of the system, dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.
- I. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

- J. Re-commissioning – After 90 days from occupancy the factory authorized representative and electrical contractor shall re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity
- K. Owner operation memo- Lighting control manufacturer shall prepare an operational memo for owner to distribute informing building occupants of the operation of their lighting control system. Memo shall explain the following but not limited to: auto on/ vs manual on, occupancy sensors, daylight harvesting, plug load control, after hours time delays.

END OF SECTION 26 09 43

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

- A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

- A. New: Provide all new equipment.
- B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
- D. NEC: Equipment and installation shall comply with the National Electrical Code.
- E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
- F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

- A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

- A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

- A. Provide complete product data for each equipment type. Provide electric service studies when required.
- B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings. Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

- C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

- A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

- A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.
- C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.
- D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.
- E. Provide Arc Flash Hazard Analysis per Specification 26 05 73.19 Arch-Flash Hazard Analysis
- F. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 OWNER'S INSTRUCTION

- A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. Instruction shall include a functional training session on digital metering system operation and system test procedures. Demonstrate the transfer of metered values to the Building Automation System. Review manufacturer's

recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
1. Schneider Electric
 2. Siemens
 3. ABB
 4. Eaton

2.2 ARC FAULT REDUCTION

- A. The following static or adjustable circuit breakers shall be provided with Reduced energy Let-Through (RELT) switch with local status indicator in accordance with the NEC requirements
1. Circuit breakers rated 1,200 amperes or larger
 2. Circuit breakers identified in an Arc-flash Hazard Analysis Study, as specified under Section 26 05 73.19
- B. Documentation identifying the location of the circuit breaker and the arc-energy reduction method shall be provided.

2.3 ENCLOSED SWITCHES

- A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.
- B. Switch Interior:
1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
 2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
 3. All current carrying parts shall be plated to resist corrosion.
 4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
 5. Switches shall have provisions for a field installable electrical interlock.
- C. Switch Mechanism:
1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
 2. The operating handle shall be an integral part of the box, not the cover.
 3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
 4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
 5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

- D. Switch Enclosures:
 - 1. Switch covers shall be attached with welded pin-type hinges.
 - 2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
 - 3. The enclosure shall have ON and OFF markings stamped into the cover.
 - 4. The operating handle shall be provided with a dual colored, red/black position indication,
 - 5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
 - 6. Tangential knockouts shall be provided to facilitate ease of conduit entry.
- E. Switch Ratings:
 - 1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
 - 2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
 - 3. Non-Fusible: 10,000 rms symmetrical amps.
- F. Fuse Clips: NEMA FU 1, Class J fuses.

2.4 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.
- C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.
- D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
- E. Nameplate: Provide a nameplate showing load served.

2.5 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

- A. Square D - Class 2510 Type F.
 - 1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
 - 2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.6 MAGNETIC MOTOR CONTROLLERS

- A. Square D - Class 8536 Type S.
 - 1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
 - 2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
 - 3. Coil: Be of encapsulated type.
 - 4. Poles: as indicated.

5. Size: as indicated.
6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
7. Wiring: Straight-through wiring with all terminals clearly marked.
8. Overload Relay: NEMA ICS.
 - a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
11. Provide red LED running pilot light and H-O-A switch.

2.7 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

- A. Square D - Class 8810 Type S.
 1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
 2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
 7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 8. Wiring: Straight-through wiring with all terminals clearly marked.
 9. Overload Relay: NEMA ICS.
 - a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
 10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
 11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.8 COMBINATION DISCONNECT / MOTOR STARTERS

- A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).
 1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
 2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
 3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.9 FUSES (600 VOLTS AND BELOW)

- A. Manufacturers:
 1. Bussmann.
 2. Little Fuse
 3. Ferraz Shawmut
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Class J (Time Delay) Fuses
 1. Dimensions and Performance: NEMA FU 1.
 2. Voltage: Rating suitable for circuit phase-to-phase voltage.
 3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.
- E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.10 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;
- D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.

- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.
- H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
- I. Provide ground-fault circuit breaker for each heat trace branch circuit.
- J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.
- A. sizes.

PART 3 - EXECUTION

3.1 MOUNTING:

- A. General: All equipment shall be securely fastened in place.
- B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.
- C. Concrete Pads:
 - 1. Provide concrete in accordance with the Division of the Specifications for that product.
 - 2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
 - 3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.
- A. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.
- B. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

- A. General:
 - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
 - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
 - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
 - 4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
 - 5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
- B. Approved Conditions for Equipment Storage:
 - 1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
 - 2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
 - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
 - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
 - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
 - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

- A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 LABELING:

- A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

- A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.
- C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

- A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
 - 1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
 - 1. Leviton 1223 Series, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:
 - 1. Leviton 1224 Series, 20A, 120/277V.
- E. Indicator Switch, Toggle Style:
 - 1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.

- F. Locator Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.

- G. Digital Time Switch:
 - 1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.

- H. Key lock switches:
 - 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
 - 2. 20 Amp rated.
 - 3. 120/277 Volt ac rated.
 - 4. Key-lock mechanism can only be turned ON or OFF with key.
 - 5. Single pole: Leviton 1221-2KL or approved equal.
 - 6. 3-Way: Leviton 1223-2kl or approved equal.
 - 7. 4-Way: Leviton 1224-2kl or approved equal.
 - 8. Provide 302 stainless steel wall plate for each switch.
 - 9. Provide 2 keys on ring for each switch.
 - 10. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
 - 11. Key all switches alike to match the owners standard key. Coordinate with school District for key match.

- I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.

- B. Leviton MMS Series.

2.4 WALL DIMMERS

- A. Manufacturers:
 - 1. Lutron Nova "T" Series.

- B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.

- C. Body and Handle: Linear slide handle, color as selected by Architect.

- D. Voltage: 120 volts.

2.5 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Leviton 5362A Series, 20A/125V.

- B. Duplex Convenience Receptacle:
 - 1. Leviton 5362 Series, 20A/125V, respectively.

- C. GFCI Receptacle:

1. Leviton 7899 Series, 20A/125V.
 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).
- D. Isolated Ground Duplex Receptacle:
1. Leviton 5362-IG, 20A/125V.
- E. Duplex Tamper Resistant Receptacle/ USB Charger
1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.
- F. Provide 20 amp receptacle for single-receptacle branch circuits.
- G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.
- H. Color: As selected by Architect.

2.6 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

2.7 DEVICE COVERPLATE LABELING

- A. Provide machine-printed adhesive labels on receptacle and switch coverplates.
- B. Labels shall be:
1. Printed using thermal transfer labeler (P-TOUCH or approved equivalent).
 2. Laminated type with clear protective overlay.
 3. Black lettering on white background with 1/4" high lettering unless noted otherwise. Provide uniform text size and format throughout project.
 4. White lettering on red background for devices served by emergency power.
 5. Label size shall not obstruct device operation or coverplate fasteners.
- C. Label material shall be durable and suitable for the environment installed, including resistance to moisture, abrasion, and cleaning solutions
- D. Handwritten or not-laminated labels are not acceptable.
- E. Provide coverplate labels for the following:
1. All receptacles requiring panelboard and circuit identification including receptacles serving dedicated equipment or special purpose loads.
 2. All switches including general room lighting.
 3. Devices where function is not readily apparent or as directed by owner.
- F. Install labels
1. Straight, level and centered on coverplate.
 2. With consistent location and orientation throughout project.
 3. After final cleaning of coverplates to ensure proper adhesion.
- G. Label content shall include:
1. Panelboard designation and circuit number (E.G. "L1-12").

2.8 MANUFACTURERS

- A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
 - 1. Leviton
 - 2. Pass & Seymour
 - 3. Hubbell / Bryant
 - 4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Route raceway and cable to meet Project conditions.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.
- D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaires complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.
- C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Provide luminaires listed by U.L.
 - 2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
 - 3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.
- B. Certification: Certify that fixture submittals have trim compatible with ceilings being installed.
- C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

- A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.
- B. Provide two (2) spare drivers for each fixture type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Acceptable Manufacturer Representatives:
 - 1. CW Lighting
 - 2. PSA Lighting
 - 3. Lesco
- B. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.
- C. All luminaires shall be new and of specification grade.
- D. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.
- E. Wire guard at fixtures in mechanical, electrical, and high abuse areas.
- F. Approved equal: Contractor may submit luminaires from other manufacturers. Contractor shall provide a full set of submittals per paragraph 1.2 of this specification section for Engineer and Architects approval. Contractor must have approved submittals stamped and dated from the Engineer and Architect minimum 10 days prior to bid.

2.2 LED LUMINAIRES

- A. Quality Assurance
 - 1. DOE Lighting Facts certified.
- B. LED Specifications
 - 1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
 - 2. CRI: >80 minimum (general); >90 healthcare and retail.
 - 3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
 - 4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
 - 5. Outdoor luminaires to be rated to a minimum of 40° C.
- C. Lumen Maintenance
 - 1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25° C, outdoors at an ambient temperature of 40° C.
- D. Thermal Testing
 - 1. ISTM testing in accordance with UL 1598-2008.
- E. Driver
 - 1. 0-10V enabled.
 - 2. Output Class 2 rated.
 - 3. Dimming range: 5-100%.
 - 4. Constant current.
 - 5. THD @ max load: <20%.
 - 6. Power factor: >0.95
 - 7. Environment protection rating: UL Damp and dry.

- 8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
- 9. ROHS Compliant
- F. Fixture photometry
 - 1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
 - 2. System flux measured in delivered lumens.
- G. Warranty
 - 1. 5 year total system warranty.

2.3 EMERGENCY BATTERY PACKS

- A. Provide emergency battery pack for fixtures designated to have emergency battery back-up.
- B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.
- C. Provide unswitched alternating current power source per manufacturer's instructions.
- D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.
- E. For fixtures designated to have emergency battery pack and on a contactor controlled circuit, provide an unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.
- F. Battery pack shall provide 1100 lumen output for 90 minutes per 2'x4' light fixture.
- G. Provide integral battery pack for all exit signs where emergency generator power is not available. Battery pack shall provide minimum of 90 minutes output.

2.4 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

- A. Provide a UL 1008 automatic transfer switch for each switch group containing lighting fixtures shown to be on emergency.

2.5 DOWNLIGHT FIXTURES

- A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.6 EXIT SIGNS

- A. Exit signs shall meet visibility requirements and be listed per UL 924 " Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.
- B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.
- C. Product Description:
 - 1. LED Exit Sign:
 - a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.

- D. Housing: Diecast aluminum with stencil face and matte white paint finish.
- E. Input Voltage: 120/277 volt, dual input voltage.
- F. EPA Energy Star Label.
- G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.7 OUTDOOR LUMINAIRE POLE ASSEMBLIES

- A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.
- B. 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.
- C. Minimum Wind Speed: 120 miles per hour or local wind ratings, whichever is higher.
- D. Metal poles shall comply with NEC 410-15(b).
- E. Pole Material: Steel.
- F. Pole Shape: Round tapered.
- G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.
- H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
- B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
- C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. General: All luminaires shall have proper supports.
- B. Install suspended luminaires using pendants supported from swivel hangers.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

- E. Chain Hung: Unless otherwise indicated all LED fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.
- F. Suspended Ceilings:
 - 1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
 - 2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
 - 3. Luminaires shall be centered in ceiling tile.
 - 4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
 - 5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.
- G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

- A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

CLEANING

- A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.

- B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.6 OUTDOOR LUMINAIRE POLES

- A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.
- B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole to be refinished at pole factory.
- C. Installation:
 - 1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
 - 2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
 - 3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
 - 4. Minimum wire size for circuit tap inside pole shall be AWG #12.
 - 5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.
- D. Fusing:
 - 1. Install fuse holder and fuses as noted in pole base detail on Drawings.
 - 2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.
- E. Grounding:
 - 1. Install #8 ground wire bonded to pole with lug as noted in pole base detail on drawings.
 - 2. Provide a 3/4"X10' copperweld ground rod driven into earth with the ground wire bonded by cadweld process as noted in pole base detail on drawings.

END OF SECTION 26 50 00

SECTION 26 56 68 – EXTERIOR ATHLETIC LIGHTING

Lighting System with LED Light Source

PART 1 – GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for Lamar Consolidated Independent School District – Gene Tomas High School using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.
- C. The sports lighting will be for the following venues:
 - 1. Football with track
 - 2. Baseball
 - 3. Softball
 - 4. Tennis
 - 5. Field Events
- D. The primary goals of this sports lighting project are:
 - 1. **Guaranteed Light Levels:** Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
 - 2. **Environmental Light Control:** It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
 - 3. **Cost of Ownership:** In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
 - 4. **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.

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
Football Field	50 Footcandles	2:1	72	30'x30'
Soccer Field	50 Footcandles	2:1	84	30'x30'
Track	30 Footcandles	2.5:1	44	30'x30'
Field Events	30 Footcandles	N/A	160	20'x20'
Bleachers	10 Footcandles	N/A	36	10'x10'
Egress	2 Footcandles	N/A	36	10'x10'
Baseball Infield	50 Footcandles	2:1	25	30'x30'
Baseball Outfield	30 Footcandles	2.5:1	85	30'x30'
Bleachers	10 Footcandles	N/A	34	10'x10'
1 st & 3 rd Base Bullpen	20 Footcandles	N/A	14	10'x10'
Batting Cage	20 Footcandles	N/A	32	10'x10'
Egress	2 Footcandles	N/A	34	10'x10'
Softball Infield	50 Footcandles	2:1	25	20'x20'
Softball Outfield	30 Footcandles	2.5:1	77	20'x20'
Bleachers	10 Footcandles	N/A	21	10'x10'
1 st & 3 rd Base Bullpen	17 Footcandles	N/A	12	10'x10'
Batting Cage	20 Footcandles	N/A	24	10'x10'
Egress	2 Footcandles	N/A	21	10'x10'
Tennis	50 Footcandles	2:1	30	20'x20'
Egress	2 Footcandles	N/A		

- B. Color Temperature: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.
- C. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare onfield and providing sufficient uplight.
1. Aiming Angles: To reduce glare, luminaire aiming should ensure the top of the luminaire field angle (based on sample photometric reports) is a minimum of 10 degrees below horizontal.
 2. Glare Control Technology – Luminaires selected should have glare control technology including, but not limited to: external visors, internal shields and louvers. No symmetrical beam patterns are acceptable.
 3. Aerial lighting – Adequate illumination must be provided above the field in order 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.
 4. 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
9	T1-T9	50'
2	A3-A4	60'
7	A1-A2, B3-B4, C1-C2, P1	70'
6	B1-B2, F1-F4	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.

1.4 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. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.
- C. System Description: Lighting system shall consist of the following:
 - 1. Galvanized steel poles and cross-arm assembly.
 - 2. 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.
 - 3. 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-inforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
 - 4. 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 located 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.

EXTERIOR ATHLETIC LIGHTING

5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
 6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.
 7. Control cabinet to provide remote on-off control, monitoring of the lighting system. See Section 2.3 for further details.
 8. 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.
- D. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

- A. Electric Power Requirements for the Sports Lighting Equipment:
1. Electric power: 480 Volt, 3 Phase
 2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.
- B. Energy Consumption: The kW consumption for the field lighting system shall be 201.92kW.

2.3 CONTROL

- A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.
- B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.
- C. Contactor control of lights: To minimize wear on drivers and other electrical components and prevent lights from turning on due to communication loss, circuits must be controlled via contactor switching, not dimming driver output to zero.
- D. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, fax, email).
- E. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.
- The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands by phone. Scheduling tool shall be capable of setting curfew limits.
- Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.
- F. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if

individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

- G. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility
2. Report hours saved by using early off and push buttons by users.

- H. Player-Activated pushbutton with strobe to provide timed on/off control for both the track and tennis courts.
- I. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.
- J. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

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 C.
- 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. Terracon Consultants, Inc. Report #92225572, Dated February 14, 2023

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:
1. Providing engineered foundation embedment design by a registered engineer in the State of Texas for soils other than specified soil conditions;
 2. Additional materials required to achieve alternate foundation;
 3. 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 weeks 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

1. 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.
 2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
 3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios 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.

PART 4 – DESIGN APPROVAL

4.1 PRE-BID SUBMITTAL REQUIREMENTS (Non-Musco)

- A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.1.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.
- B. Approved Product: Musco's Light-Structure System™ with TLC for LED® is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.
- C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.
- D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. **Submit checklist below with submittal.**

Yes/ No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the State of Texas, if required by owner. (May be supplied upon award).
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the State of Texas.
	I	Electrical Distribution Plans	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the State of Texas.
	J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the State of Texas.
	K	Project References	Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the State of Texas. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	L	Product Information	Complete bill of material and current brochures/cut sheets for all products being provided.
	M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	O	Cost of Ownership	Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 25 Years

The information supplied herein shall be used for the purpose of complying with the specifications for Lamar Consolidated Independent School District – Gene Tomas High School. By signing below, I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer: _____

Signature: _____

Contact Name: _____

Date: ____/____/____

LEAF Engineers
Project No. 250515

Tomball ISD Athletic Improvements
Tomball Independent School District

Contractor: _____

Signature: _____

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 – GENERAL

1.01 RELATED WORK

- A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.02 SCOPE OF WORK

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.03 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.
- D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.04 CODES AND STANDARDS

- A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.
- B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
- C. ANSI/TIA:
 - 1. ANSI/TIA-526-7A:2015 (R2022) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - 2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
 - 3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
 - 4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - 5. ANSI/TIA-568.0-E (2020) Generic B (supersedes TIA-568-C.0 and TIA-568-C-1)
 - 6. ANSI/TIA-568.1-E (2020) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)
 - 7. ANSI/TIA-568.2-E (October 2024) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - 8. ANSI/TIA-568.3-E (September 2022) Optical Fiber Cabling Components Standard
 - 9. ANSI/TIA-568.4-E (July 2022) Broadband Coaxial Cabling Components Standard
 - 10. ANSI/TIA-569-E Addendum 1 (2022) Telecommunications Pathways and Spaces
 - 11. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding, with Addenda 1 & 2.
 - 12. ANSI/TIA-570-E (May 2024) Residential Telecommunications Infrastructure Standard
 - 13. ANSI/TIA-606-D (October 2021) Administration Standard for Telecommunications Infrastructure
 - 14. ANSI/TIA-607-E (May 2024) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - 15. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 - 16. ANSI/TIA-862-D (June 2022) Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - 17. ANSI/TIA-942-C (May 2024) Telecommunications Infrastructure Standard for Data Centers
 - 18. ANSI/TIA-1005-A (March 2020) Telecommunications Infrastructure Standard for Industrial Premises
 - 19. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
 - 20. ANSI/TIA-1183-B (February 2023) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
 - 21. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz – Incorporated into TIA-1183-B
 - 22. TIA-1152-A (June 2025) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - 23. TIA-1179-B (June 2023) Healthcare Facility Telecommunications Infrastructure

Standard

24. ANSI/TIA-4966-A (February 2022) Telecommunications Infrastructure Standard for Educational Facilities. Addendum: TIA-4966-A-1, (March 2023), adds support for single-pair cabling
25. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
26. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
27. TIA-604-18-A (April 2024) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
28. TIA-604-5-F (March 2019) FOCIS 5 Fiber Optic Connector Intermateability Standard-Type MPO
29. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
30. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
31. TSB-184-A (March 2017) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
32. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
33. TSB-190-A (December 2023) Guidelines on Shared Pathways and Shared Sheaths
34. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
35. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
36. TIA-492AAAE (June 2016) Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
37. TIA-492AAAB-A (November 2009) Detail specification for 50-µm core diameter/125-µm cladding diameter class 1a graded-index multimode optical fibers
38. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
39. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

D. ISO/IEC:

1. ISO/IEC TR 11801-9911:2024 – Guidelines for balanced single-pair applications within 4-pair cabling
2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
3. ISO/IEC 11801-5:2017 – Generic cabling for data centers
4. ISO/IEC 11801 series, including: 11801-1:2017 (General) 11801-2:2017 (Office premises)
5. ISO/IEC 11801-4:2017 – Generic cabling for homes
6. ISO/IEC 11801-3:2017 – Generic cabling for industrial premises
7. ISO/IEC 14763-2:2019 – Planning and installation
8. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
9. ISO/IEC 14763-3:2024 – Testing of optical fiber cabling
10. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
11. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
12. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment

- E. BICSI – Building Industry Consultative Services International – Published Standards
 - 1. ANSI/BICSI 001-2017 (R22) – ICT Systems Design for Educational Institutions
 - 2. ANSI/BICSI 002-2024 – Data Center Design and Implementation Best Practices
 - 3. ANSI/BICSI 003-2024 – BIM Practices for ICT Systems
 - 4. ANSI/BICSI 004-2018 – ICT Design for Healthcare Facilities
 - 5. ANSI/BICSI 007-2020 – ICT Design for Intelligent Buildings
 - 6. ANSI/BICSI 006-2020 – DAS Design and Implementation Best Practices
 - 7. ANSI/BICSI N1-2019 – ICT Installation Practices
 - 8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - 9. BICSI – Building Industry Consultative Services International – Manuals
 - 10. Telecommunications Distribution Methods Manual, TDMM 15th Edition (2024)
 - 11. Information Transport Systems Installation Methods Manual, ITSIMM 8th Edition (2022)
 - 12. Outside Plant Design Reference Manual, OSPDRM 6th Edition
 - 13. BICSI's ICT Terminology Handbook, Version 1.0
 - 14. Telecommunications Project Management Manual, TPMRM 2nd Edition
 - 15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
 - 16. BICSI's Special ICT Design Considerations, Version 1.0
 - 17. Essentials of Bonding and Grounding, Version 1.0
- F. National Electric Codes
 - 1. National Electrical Safety Code IEEE C2-2023 (NESC 2023 Edition)
 - 2. NFPA 70-2023 (NEC 2023 Edition)
 - 3. ANSI/ IEEE C2-2023, National Electrical Safety Code®
 - 4. National Electrical Code (NEC) (NFPA 70-2023)
 - 5. NFPA 72 National Fire Alarm and Signaling Code, NFPA 72-2025 Edition
- G. ASHRAE
 - 1. ANSI/ASHRAE Standard 90.4-2022, Energy Standard for Data Centers and Telecommunications Buildings
- H. OSHA Standards and Regulations – all applicable
- I. Local Codes and Standards – all applicable
- J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
- K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.
- L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.
- M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.05 EXISTING UTILITIES

- A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.06 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

- A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

- A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material

which meet the specifications.

- D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

- A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.
- B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.
- C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

- A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.
- B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.
- C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor_____

Signed_____

Position_____

Date_____

*Refer to exception requirements herein.

- D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:
1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.
 2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.
 3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.
 4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.
- E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the Engineer's filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed index sheets also for the Engineer's filing convenience.
- F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.
- G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.

- H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
- I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

- A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as required.

3.05 CUTTING AND PATCHING

- A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.
- B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by the Contractor.
- C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

- A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

- A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley

adjacent to the site.

- B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

- A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.
- B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered in place or an approved mastic sealer.
- C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

- A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.
- B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.
- C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

- A. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping other trades.

3.11 RECORD DRAWINGS

- A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and

dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

- A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.
- B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
 - 1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.
- C. The manual shall include the following information
 - 1. Manufacturer's installation instructions.
 - 2. Manufacturer's local representative and/or distributor's name and address.
 - 3. Manufacturer's operating and maintenance instructions.
 - 4. Manufacturer's internal wiring diagrams.
 - 5. Contractor's installation wiring diagrams.
 - 6. Replacement part number listings and descriptions.
 - 7. Framed operating instructions, when required, in individual Specification sections.
 - 8. Warranties and guarantees.
 - 9. Provide an approved submittal at the front of each section.
- D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.
- E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
 - 1. Each section in the manual shall identify the grouping of all literature required for the system or equipment included.
 - 2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
 - 3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

- 1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.

2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.
4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.
3. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner.

All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION

SECTION 27 10 00 – CATEGORY 6 STRUCTURED CABLING SYSTEM (SCS)

This specification section is provided as part of the early equipment procurement package and outlines the manufacturers and model numbers of the equipment to be purchased. Reference the drawings and equipment schedules for actual equipment identified as being part of the early procurement package. All other references to installation and products will be part of the base bid construction package issued at a later date. Several sections within this specification have been highlighted to help identify equipment that is expected to be part of the early equipment procurement package.

Complete equipment submittals are due at the time of pricing submission for the early equipment package. Any pricing submitted without a submittal package will not be accepted. All submittals shall contain line by line specification compliance to indicate proposer is complying with equipment listed in this specification. Any deviations from the specification should be highlighted and identified and reason for deviation. Any incomplete submittals will not be accepted.

Reference the front-end documents for information related to equipment delivery dates, equipment storage requirements, warranty and process for unloading equipmentP to owner designated location.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes

1.3 DESCRIPTION

- A. Summary of Work:
 - 1. Provide a complete and tested Category 6 cable distribution system for data interconnections (Local Area Network). The data distribution system shall include fully terminated unshielded twisted pair cables, raceways, conduit, UTP termination devices, data communications outlets, patch panels, patch cables, network racks, and other incidental and miscellaneous premises wiring system hardware as required for a complete and usable system. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
 - 2. Provide and install (1) 12-strand single mode fiber-optic cable and (1) 25-pair Category 3 copper tie cable from the MDF to each IDF.
 - 3. Provide and install building entrance terminals as required.

1.4 QUALITY ASSURANCE

- A. Acceptable manufacturers:
 - 1. The equipment/products described herein, and furnished per these specifications shall be the product of one manufacturer. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required
 - 2. The approved installer shall provide a complete Category 6 solution with a 25-year extended product warranty and application assurance.
 - 3. Acceptable product connectivity and cable shall be Uniprise by CommScope.

Only the manufacturers listed in this paragraph will be accepted.

- B. Installer Qualifications:
1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) similar size, Category 6 and/or Category 6A projects and contact names confirming successful premises wiring system installations.
 2. The SCS Installer shall be a certified CommScope Uniprise and in good standing in the Partner Program, local area, integrator and must be able to provide the manufacturer's maximum available warranty on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.
 3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
 4. All individuals installing the SCS must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
 5. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.
- C. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant and individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
- D. Acceptance:
1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
1. The selected system installer shall be a CommScope Uniprise, certified contractor and hold current certification. Contractor shall provide an end-to-end performance warranty of not less than twenty (25) years on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Category 6 and Category 6A cable links have been tested bi-directionally (end to end) using a Level 2 tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-C and/or TSB-67 Link values.
 2. The warranty will also cover fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
 3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.5 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the

following standards and codes:

1. Latest Local Codes and Amendments
2. 2012 National Electrical Code

B. Other References:

1. TIA/EIA-568-C Commercial Building Telecommunications Wiring Standard
2. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
3. TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. EIA/TIA 455-A Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
6. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
7. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
8. ISO/IEC 11801 Generic Cabling Standard
9. EN 50173 Generic Cabling Standards for Customer Premises
10. ANSI/EIA/TIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.6 ABBREVIATIONS

A. The following abbreviations are used in this document:

DC	Direct Current
IDF	Intermediate Distribution Frame
MDF	Main Distribution Frame
PBX	Private Branch Exchange
UTP	Unshielded Twisted Pair

1.7 SUBMITTALS

A. Project Initiation:

1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
 - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
 - b. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided

- c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - d. Testing: Proposed Contractor Category 6 UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
 - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
 - f. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - 1) BICSI RCDD Certification: This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the projected.
 - 2) Proposed Manufacturer's Strategic Partner Certification: This certification have been obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.
 - 3) Proposed Manufacturer's Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - 4) Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.
- B. Shop Drawings:
- 1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.
 - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 2) Location of sleeved wall pass-thru
 - 3) Size of sleeve at each location installed
 - 4) Quantity of cable passing through each sleeve
 - 5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - 6) Conduit routing, size, quantity, and stub-up locations for all floor

mounted outlets.

- c. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

C. Close-out Procedures:

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 - c. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed, a list of recommended spare parts.
 - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - g. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2019 or later. Provide the Owner with electronic versions of the As-Built on (2) 8GB thumb drives.
 - h. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - i. A copy of the manufacturer's warranty on the installed system.
 - j. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - k. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
 - l. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included

systems and equipment. Minimum amount of training time shall be at least 4 hours.

- m. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF and/or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.
- C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements listed under section 1.5.
- D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
 - CM Communications Cable
 - CMP Plenum Rated Communications Cable
 - CMR Riser-Rated Communications Cable
- E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.
- F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
 - 1. Approved Products
 - a. Twisted-pair cable: Dyna-Blue
American Polywater
- G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
 - 1. Approved Products
 - a. 3M or
 - b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) CATEGORY 6 TERMINATION HARDWARE

- A. Equipment Racks/Cabinets:

Provide and install equipment racks and/or cabinets in locations indicated on the attached drawings for the following areas.

CATEGORY 6 STRUCTURED CABLING SYSTEM (SCS)

For all IDF and MDF locations:

Contractor shall provide and install new Chatsworth floor mounted rack systems. Refer to floor plan and enlarged MDF/IDF room layouts for number or racks to provide at each location.

1. Approved Products
 - a. Floor mounted racks – Chatsworth 55053-703

For IDF rooms that are not dedicated spaces or have public access, provide

1. Wall mounted cabinet – Chatsworth part number 13492-772.

B. Distribution Rack/Cabinet Grounding

All Racks and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.

1. Approved Products –Grounding Compression Lugs
NSi #L6N-14
2. Approved Products – Wall Mount Bus Bar (one per MDF/IDF location) Hoffman #DGTB412

C. Fiber Optic Patch Panels

The enclosures used shall provide termination panels for LC type connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19" rack mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.

1. Approved Products (for MDF/IDF locations):
 - a. CommScope 2U Fiber Shelf 760251045 EPX- 2U-PNL-ENC
 - b. CommScope 4U Fiber Shelf 760251049 EPX- 4U-PNL-ENC
 - c. CommScope 12 Fiber Inserts LC Single-Mode 760067165 | PNL-BK-012-SFA-LC02-BL-Shuttered
 - d. CommScope Wall Mounted Single Sided Single Door Fiber Enclosure 769248905 | WB2-EMT-BK-2P-PNL
 - e. Provide cable grommets AMP #559496-2, or equivalent cable grommet.

D. Category 6 Patch Panels: The Category 6 data station cable shall be terminated on Category 6 RJ45 patch panels with circuit board construction, T568B terminations. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

1. Approved Products:
 - a. CommScope Category 6 Patch Panels 24 Port 760207274 | CPP-UDDM-M-1U-24
 - b. CommScope Category 6 Patch Panels 48 Port 760207282 | CPP-UDDM-M-2U-48
 - c. Provide cable support bars at the back of all patch panels to provide additional support at rear of rack and panels

- E. Category 6A Patch Panels: The Category 6A Wireless Access Point (WAP) station cable shall be terminated on Category 6A RJ45 patch panels with circuit board construction, T568B terminations. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568AS standards.
1. Approved Product
 - d. CommScope Category 6 Patch Panels 24 Port 760207274 | CPP-UDDM-M-1U-24
 - e. CommScope Category 6 Patch Panels 48 Port 760207282 | CPP-UDDM-M-2U-48
 - a. Provide cable support bars at the back of all patch panels to provide additional support at rear of rack and panels.
- F. Cable Management Panels
Provide cable management panels as required for horizontal and vertical cable management. Provide vertical wire management on ends and in between all racks on entire project. All vertical cable managers on the entire project shall be 10" wide management.
1. Approved Products

Horizontal – Hoffman DCHD2 (Verify with district prior to ordering)

Vertical – Hoffman DV10DF7
Provide Velcro straps for cable dressing in MDF/IDF rooms.
- G. Rack/Cabinet Electrical:
1. A power distribution strip shall be installed vertically at the back of each data rack and/or cabinet.
Approved Products
 - a. Chatsworth P-11D0A5 120V 20A
 - b. Provide a PDU offset bracket for each PDU installed.
 - Provide the following electrical UPS equipment at each location indicated.
- At MDF room: (Provide quantity of two (2) each of the following at the MDF)
- Smart-UPS 3000VA USB & Serial RM 2U 120V
APC Product Number: DUA3000RM2U (black chasis)
- UPS Network Management Card 2 with Environmental Monitoring
APC Product Number: AP9631
- 3 year extended warranty
APC Product Number: WBEXTWAR3YR-SP-04
- At IDF Room: (Provide quantity of one (1) each of the following at each IDF)
- Smart-UPS 3000VA USB & Serial RM 2U 120V

APC Product Number: DUA3000RM2U (black chasis)

UPS Network Management Card 2 with Environmental Monitoring
APC Product Number: AP9631

3 year extended warranty
APC Product Number: WBEXTWAR3YR-SP-04

- H. Network Rack Patch Cables: Cabling Contractor shall provide district with (1) – 6' Category 6 patch cable for each data drop and (1) – 6' Category 6A for each WAP drop on entire project.. These cables will provide connectivity from the front of the network patch panels to the network equipment provided by district upon move-in. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.
1. Approved Products: CommScope 6' Category 6 Patch Cable
 - a. Blue in color for all data drops on the entire project UC1BBB2-0ZF006
 - b. Green in color for all IP Cameras drops on the entire project UC1BBB2-0MF006
 2. Approved Products: CommScope 6' Category 6A Patch Cable
 - a. Yellow in color for all Access Point drops on the entire project UC1AAA2-09F006

2.3 CABLE ROUTING/PATHWAY

- A. Cable Tray: Metal cable tray shall be provided to affix to the top of all floor mount racks. Cable tray shall be used to brace racks to walls and to route cable from walls to racks in communication closets.
1. Approved Products:
 - a. CommScope 760085647 | CR-SLR-10L12W (black)
 - b. And all applicable installation accessories and those listed below:
 1. Cable Runway Elevation Kit (CPI) - #10506-706 (black) –one per rack
 2. 3" Channel Rack-to-Runway Mounting Plate CommScope 760084053 | CRR2RRMK (black) one per rack
 3. Cable Runway Radius Drop: CommScope 760083956 | CRDK-12W (black).
 4. Ladder Rack 90° Horizontal E-Bend Section: CommScope 760085530 | CR90FCB-12W (black). Provide as required.
 5. Wall Angle Support Kit: CommScope 760084160 | CR12-C24WRSK (black). Provide as required per ladder tray and wall junction.
 6. End Cap Kit: CommScope 760084012 | CRPECK (black). Provide as required per exposed end of ladder tray
 7. Junction Splice Kit: CommScope 760084046 | CRTJSK (black). Provide as required per junction.
 8. And all applicable installation accessories.
- B. Cable Support System:
- C. All low voltage cabling shall be installed and supported using a modular cable support system at 48" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- D. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
- E. Innerduct shall be provided for non-armored fiber cabling and shall be bright orange and labeled and shall be provided for fiber optic cables from fiber patch panel to conduit or plenum and conduit entrances. Innerduct installed in plenum rated ceilings shall be

plenum rated.

1. Approved products
 - a. Carlon
 - b. Dura-line

2.4 FIBER OPTIC PRODUCTS

A. Fiber Optic Cable shall be UL listed type OFNP (unless noted otherwise):

1. Single-mode:
 - a. Single-mode fibers, each with a color-coded PVC tight buffer (unless noted otherwise) shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
 - b. Approved Products:
 - i. 12-strand Single-mode, with plenum rated armored jacket shall connect each IDF with the MDF as specified on Technology Plans. CommScope Product #760127803 | P-012-DZ-8W-FSUYL
 - ii. 12-strand Single-mode, with an indoor/outdoor plenum rated jacket, with no metallic elements, shall connect each IDF (that is not connected to the main buildings) with the MDF as specified on Technology Plans. CommScope Product #760037192 | P-012-OD-8W-FSUBK
3. Provide 4 qty. CommScope 3-meter patch cords for each backbone fiber installed on the entire project. Coordinate the required connector type, on the equipment end, with the owner prior to procuring the products.
4. No fusion or mechanical splices will be allowed at any point in the fiber optic runs.

B. Connectors

Optical Fiber Connectors shall be LC type connectors.

1. Approved Products:

CommScope LC Single-Mode #760117895 | SFC-SLCF-09-8X Qwik II LC

2.5 STATION WIRING

- A. Wireless Access Points shall be cabled with Category 6A unshielded twisted pair, four-pair, 24 AWG solid copper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for WAP Locations.
1. Approved Products: For all WAPs:
 - a. Plenum-Rated CommScope Category 6A (Yellow color for all Access points drops on entire project)
 - 1) CommScope Part # CS44P-YEL
- B. Wire: The data and voice wire provided for all outlets shall be (Category 6) unshielded twisted pair, four-pair, 24 AWG solid copper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for number of active data ports to specified faceplates.
1. Approved Products: For all voice and data connections:
 1. Plenum-Rated CommScope Category 6 (blue color for all voice/data drops on entire project)

- 2) CommScope Part #CS37P BLU
 - b. Plenum-Rated CommScope Category 6 (green color for all IP Cameras drops on entire project)
 - 3) CommScope Part #CS37P GRN
- C. Indoor/Outdoor Plenum Copper cable- For those locations where we will need to run short runs of copper cable from building to building or within a "wet environment" (in slab) provide the following cables:
 - 2. Approved Products: For all voice and data connections:
 - a. CS34P-IO Indoor/Outdoor Category 6 U/UTP, Plenum, Outdoor Rated, Black Jacket, 4 Pair Count
 - b. CS44P-IO Indoor/Outdoor Category 6A U/UTP, Plenum, Outdoor Rated, Black Jacket, 4 Pair Count
- D. Testing: The Category 6 four-pair UTP cable must be UL Performance Level tested. Each 1000 foot spool must be individually tested with test results affixed to the spool. All cable must be provided on new 1000 foot spools. NO "SHORTS" WILL BE ALLOWED. IF SHORTS ARE DISCOVERED, THE CONTRACTOR WILL BE REQUIRED TO UNINSTALL ALL CABLE ON THE ENTIRE PROJECT AND INSTALL NEW CABLE AT NO ADDITIONAL COST TO THE OWNER.
- E. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non plenum rated otherwise.
- F. Provide 10 feet service loop at all headend locations properly supported above ceiling. Provide 3' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.
- G. All cable shall be bundled with Velcro from patch panel to outlet. Velcro shall be rated for plenum space.

2.6 STATION HARDWARE

- A. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6A RJ45 modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6 connecting hardware.
 - 1. Approved Products – WAP Jacks:
 - a. Wireless: CommScope UNJ Series #UNJ600T-YL
 - b. Wireless: CommScope USL series
- B. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6 RJ45 modular jacks with circuit board construction and IDS style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6 connecting hardware.
 - 1. Approved Products – Data and Voice Jacks:
 - a. Data/Voice: CommScope UNJ Series # UNJ600T-BLU or USL Equivalent
 - b. Security: CommScope, UNJ Series # UNJ600T-GR or USL Equivalent
 - 2. All blank inserts shall be Gray.
- C. Faceplates: Faceplates shall be a 4-port, flush mounted, **stainless steel**, CommScope Semtron solution, for RJ45 outlets at all locations.
 - 1. Approved Products:
 - a. M10L-262 (Single Gang with label)
 - b. M14L-262 (Quad Gang with label)
 - c. M10W4SP (Single Gang for wall mount phone)

- D. Workstation Patch Cables: Cabling Contractor shall provide district with (1) – 10' Category 6 patch cable for each data drop on entire project. One 10' Category 6A patch cable for each WAP drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
- E. Approved Products: CommScope Uniprise 10' Cat 6 or Cat 6A Patch Cable
 - 1. Blue in color for all Access Point drops on the entire project UC1BBB2-0ZF010
 - 2. Green in color for all IP Cameras drops on the entire project UC1BBB2-0MF010
 - 3. Yellow in color for all Access Point drops on the entire project UC1AAA2-09F010

PART 3 - EXECUTION

3.1 GENERAL

- A. Fire Wall Penetrations: The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants: After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Pull Strings: Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.
- E. Conduit Fill: Conduit fill shall not exceed 40%.
- F. Damage:
 - 1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
 - 2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up:

All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

- A. Labels

The Contractor will label all outlets using permanent/legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least on-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.

The following nomenclature should be used when labeling data/voice jacks:

- a. All cables being served by MDF closet shall begin with 'M' all IDF served cables shall begin with I# (# designated IDF closet number).
- b. Next identification letter shall refer to patch panel that is serving outlet (A,B,C...)
- c. Next identification shall note what # data port on patch panel (1 thru 48).

Example:

- a. Outlet from 23rd port of the third patch panel from top of rack located at IDF2-C23
- b. Outlet from the 5th port of the second patch panel from the top of rack located at MDF M-B5

B. Floor Plan

A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.

- C. Contractor shall label wiring on both ends of cable at workstation and headend locations with machine labels, no exceptions.

3.3 EQUIPMENT RACK CONFIGURATION

- A. Equipment Racks: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements. Placement of racks must be approved prior to installation. **Racks installed without Owner's acceptance of location shall be relocated including all related work at no cost to the Owner.**
- B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel, also 1 per patch panel should be left at site to accommodate the switch gear when they are installed. Vertical cable management panels shall be installed on each side of the rack. In instances where more than one rack is installed in a single location, vertical cable management shall be installed between the racks and on either side.
- C. Cable Placement: Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.
- D. Cable Routing: Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within

the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

- E. Installation: All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.
- F. Hardware: Provide rack and jack panel hardware as required for all data station wiring.

3.4 STATION WIRING INSTALLATION

- A. General:
 - 1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
 - 2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed enhanced Category 6 UTP cable at either the wiring closet or the workstation termination locations.
- B. Exposed Cable:
 - 1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings.
 - 2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
- C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.
- D. Cable Routes:
 - 1. All cabling placed in ceiling areas must be in conduit, cable tray or J-Hooks. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section.
 - 2. Attaching cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Chatsworth hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable rings on 36-inch maximum centers to hang cable. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling. Grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple cables to be bundled together every 6 feet.

3.5 STATION HARDWARE

- A. Flush Mount Jacks: Flush mount jacks shall be mounted in a faceplate with backbox.
- B. Placement: Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.

- C. RJ-45 Jack Pin Assignments:
 - 1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
 - 2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring).

3.6 CABLE TESTING REQUIREMENTS

- A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.
- E. Twisted Pair Cable Testing:
 - 1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Category 6 products shall be tested for compliance to ANSI/TIA/EIA 568A and ISO/IES 11801 for a Category 6 rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
 - 2. Each wire/pair shall be tested at both ends for the following:
 - a. Wire map (pin to pin connectivity)
 - b. Length (in feet)
 - c. Attenuation
 - d. Near end cross talk (NEXT)
 - e. Power Sum
 - 3. Test equipment shall provide an electronic and printed record of these tests.
 - 4. Test results for each Category 6 four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts associated with that cable.
- F. Fiber Optic Cable Testing
 - 1. Optical fiber cabling shall be tested and certified after installation as described below and as required for cable manufacturer's warranty. Fiber testing shall be performed on all fibers in completed end to end system. Testing shall consist of a bi-directional end to end test in accordance with applicable standards in 27 02 20.20, or a bi-directional end to end test performed by TIA-455-53A and all other applicable standards in 27 02 20.20. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode type glass and 1310 and 1550 nanometers for single-mode type glass. These tests shall also include

- continuity checking of each fiber. For spans greater than 90 meters, each tested span must test to a value less than or equal to value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be less than or equal to 2.0 decibels. The insertion loss for each mated optical fiber connector pair shall not exceed 0.40 decibels.
2. Pre-installation testing: Test all optical fiber cable for all fibers prior to installation of cable.
 3. Performance testing: Where links are combined to complete a circuit between devices, Contractor shall test each link from end to end to ensure performance of system. Only a basic link test is required. Contractor can optionally install patch cords to complete circuit and then test entire channel. The test method shall be same used for test described above. The values for calculating loss shall be those defined in applicable TIA standards in Appendix 1: Codes, Standards, and Informative References.
 4. Attenuation testing: Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach test equipment to cable plant. The light source shall be left in place after calibration and power meter moved to far end to take measurements.
 5. Loss budget: All fiber cabling shall be tested at both wavelengths 850 nm and 1310 nm for multimode and 1300 nm and 1550 nm for single mode.
 - a. The link attenuation shall be calculated using:
 - 1) The CommScope Fiber Performance Calculator for CommScope installations
 - 2) The following calculation for other installations:
Link Attenuation Allowance (dB) = Cable Attenuation (dB) + Connector Loss (dB) + Splice Insertion Loss (dB)
Where:
Cable Attenuation (dB) = Cable attenuation (dB/km) X Length (km)
 4. Link Loss: A mated connector to connector interface shall be considered a single connector. Loss numbers for installed link shall be calculated by taking sum of bi-directional measurements and dividing that sum by two. All links not meeting requirements of standard shall be brought into compliance by Contractor, at no additional cost to Owner.
 7. Documentation: Following final documentation shall be submitted to the owner's representative prior to commissioning data system and final contract payment according to Submittals in this section.
 8. Test results: Test results shall be automatically evaluated by equipment, using most up-to-date criteria from all applicable standards specified in 27 02 20.20 and result shown as pass/fail. Test results shall be printed directly from test unit or from a download file using an application from test equipment manufacturer. The printed test results shall include all tests performed, expected test result and actual test result achieved.
 9. End to End Loss Data: final documentation shall be submitted to the owner's representative.
 10. As Installed/ As Built Diagrams: Final documentation shall be submitted to the owner's representative.
 11. Test Documentation shall be submitted in electronic format. Certification Test Reports shall be submitted in electronic format using the appropriate software supplied by the test equipment manufacturer. The data format should be that of the test report software (i.e. *.flw files for Fluke). The contractor shall provide any necessary software to view and evaluate the test data.

3.7 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.
 - 1. Written Test Report:
 - a. Complete test results, including actual values associated with tests.
 - b. Show all certifications for telecommunications wiring systems.
 - c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCad format. Provide electronic copy of drawings to owner in AutoCad version 14 or greater.
 - d. Documentation of outlet, cable and rack labeling system.
- B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed and test results certify system to all specified standards.

END OF SECTION 27 10 00

SECTION 31 13 13.13 - WASTE MATERIAL DISPOSAL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. Waste material disposal consists of disposal of trees, brush, vegetation, rubbish and other objectionable matter from operations such as clearing and grubbing, demolition, excavation, concrete placement and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.

PART 3 - EXECUTION

3.1 DISPOSAL AREA

- A. Items noted on plans to be "removed" or "disposed" will be taken completely off the site.
- B. Concrete wash-out will become property of Contractor to be disposed of with other waste materials.

3.2 COMPACTION AND GRADING

- A. Level off waste material to an elevation 12 inches below final grade. Place excess topsoil on waste material in a layer not less than 12 inches thick and compact to the density of the surrounding area.

END OF SECTION 31 13 13.13

SECTION 31 20 00 – EARTHWORK (UNDER PAVING AND SITE APPURTENANCES)

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes the furnishing of all plant, labor, equipment, materials and the performance of all operations required to complete the Earthwork indicated on the Drawings and specified herein, including the following: Clearing and Grubbing, Stripping, Excavation, Embankment, Borrow, Subgrade Preparation, Compaction and Finish Grading.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CLEARING & GRUBBING

- A. This item shall consist of clearing the ground of all trees, brush, rubbish, and of grubbing the roadway, pavement areas, roadside ditches and/or outfall ditch right-of-way or other easements as designated within the limits of the project. The designated areas shall be cleared of stumps, brush, logs, rubbish, trees and shrubs, except such trees and shrubs and certain areas designated by the Engineer for preservation shall be carefully protected from abuse, marring or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees designated for preservation will not be permitted. Trees and shrubs designated for preservation, that must be pruned, shall be trimmed as directed by the Engineer and all exposed cuts over two (2) inches in diameter shall be treated with an approved material.
- B. On areas required for paving, channel, or structural excavation, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the lower elevation of the excavation. On areas required for embankment construction, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the existing ground surface. All holes remaining after clearing and grubbing shall be backfilled and compacted to ninety percent of Standard Proctor Density (ASTM Method D698) at a moisture content of between optimum and plus 3 percent of optimum as directed by the Engineer and the entire area bladed to prevent ponding of water and to provide drainage; except in areas to be immediately excavated, the Engineer may direct that the holes not be backfilled. On areas required for borrow sites and material sources, stumps, roots, etc., shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction.
- C. All cleared and grubbed materials shall be disposed of off site. Contractor shall be responsible for obtaining any necessary disposal permits. The Contractor shall not bury any refuse on site. No burning shall be permitted unless specifically noted and permitted by local jurisdictions.
- D. No separate measurement or payment will be made for furnishing all labor, materials, permits, supervision, equipment and supplies required to complete all items of work specified for clearing and grubbing.

3.2 STRIPPING

- A. Within the limits indicated, or in areas where existing grade is to be altered either by excavation or embankment, the Contractor shall strip existing topsoil to approximately 3-inches in depth, except that areas beneath foundations or structures shall be stripped to a minimum depth of 6-inches, and may be stockpiled for future use or disposed of at the Contractor's expense. Stripping shall include the removal and disposal of scrap iron, rubbish, logs, abandoned utilities, signs, and any and all other debris, if within the project site or right-of-way, whether above or below existing grade. Stripping and excavation can take place in the same operation, provided the topmost material is suitable for use in future construction and provided it is not to be set aside for backfill or topsoil. The upper topsoil and debris to be stripped as noted above, shall be removed regardless of whether the site is to be excavated or receive embankment. Surface soil, not suitable for use in the future construction and any other unsatisfactory material shall be excavated, removed off the site and placed in designated spoil banks or shall otherwise be disposed of as directed by the Engineer in such a manner as not to create an unsightly or objectionable condition.
- B. Stripping will not be paid for directly. Payment for stripping shall be subsidiary to excavation, borrow or embankment.

3.3 EXCAVATION

- A. Excavation shall consist of the required excavation within the project limits, the removal and proper utilization or disposal of all excavated materials; and the constructing, shaping and finishing of all earthwork on the entire project site, in conformity with the required lines, grades and typical cross sections, and in accordance with the specification requirements herein outlined. All suitable excavated materials shall be utilized, insofar as practicable, in grading the site, uniformly widening embankment, flattening slopes, etc., or as directed by the Engineer. The Engineer will define suitable materials. Unsuitable excavation in excess of that needed for construction shall be known as waste and shall become the property of the Contractor to be disposed of by the Contractor outside the limits of the site. Unsuitable material encountered below subgrade elevation, shall be replaced with material from the excavation, or with other suitable material.
- B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, including preparing ditches, trimming of slopes, disposal of surplus materials (wastage), preparation and completion of subgrade, shoulders, roadway, any necessary hauling and the furnishing of all labor, tools, equipment and incidentals necessary to complete the work.

3.4 EMBANKMENT

- A. This item shall govern for the placement and compaction of all materials obtained from the site, borrow, channels, structural and sewer excavation, including all underground utility excavation, used in the construction of project fill and/or embankment. Prior to placing any embankment, all stripping and/or clearing and grubbing operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing embankment construction.
- B. Unless otherwise indicated on the plans, the surface of the ground of all unpaved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 4-inches. The loosened material shall be recompacted with the new embankment as hereinafter specified and shall not exceed 8-inches in total depth. Where indicated on the plans or as directed by the Engineer, the surface of a hillside to receive embankment shall be loosened by scarifying or plowing to a depth of not less than 4 inches, or cut into steps, benched or notched before embankment materials are placed. The embankment shall then be placed in layers, not to exceed 8-inches, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material, which has been loosened, shall be recompacted simultaneously with the embankment material placed at the same elevation. Where embankments

are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 4-inches and the embankment built up in successive layers, as hereinafter specified to the level of the old roadbed before its height is increased. The top of the old roadbed shall be scarified and recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

- C. Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in the embankment.
- D. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the site or paving. Embankments shall be constructed to the grade established by the Engineer and completed embankments shall correspond to the general shape of the typical sections shown on the plans and each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion, the site shall be continuously maintained to its finished section and grade until the project is completed.
- E. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken, and the embankment material mixed by blading, harrowing, discing, or similar methods to the end that a uniform material is secured in each layer. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.
- F. After each layer of embankment or select material is complete, the Engineer will make tests as necessary. If the material fails to meet the density specified, the course shall be reworked, as necessary, to obtain the specified compaction. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer of asphaltic or other approved material. Embankment shall not be paid for directly, but shall be incidental to site excavation, channel excavation, construction of underground utilities, including all sewers, or borrow.

3.5 BORROW

- A. Borrow shall consist of the required excavation, removal and proper utilization of materials secured from sources obtained by the Contractor and approved by the Engineer. Borrow shall be used only when shown on the bid form or directed by the Engineer and then only from approved sources. Borrow material shall come only from sources approved by the Engineer. The Engineer shall provide samples of the fill material for testing and approval. In the event the material is not acceptable, as determined by the Engineer, the Contractor shall find other sources. All fill material shall be free from organic matter and deleterious material.
- B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price. All work performed as required herein shall be full compensation for furnishing all labor, for all materials, for all royalties and freight involved, for all hauling, delivery, spreading and compacting complete and in place and for all tools, equipment and incidentals necessary to complete the work.

3.6 SUBGRADE

- A. The subgrade shall be brought to the lines, grades and typical cross section shown on the plans and in accordance with these specifications. Whenever unsuitable natural material is encountered and cannot be handled by the excavation or embankment requirements, then the following

requirements shall apply. The unsuitable material shall be excavated to a depth deemed sufficient by the Engineer and the excavated material shall be disposed of off the jobsite at the expense of the Contractor. The excavated area shall be filled to its original level with suitable material meeting the requirements of borrow. This imported material shall be compacted to 95-percent of standard proctor density, (ASTM Method D698) using a moisture content ranging from optimum to plus 3-percent above optimum. Soils shall not be compacted at less than the optimum moisture content.

- B. After all holes and depressions are filled with approved material, the subgrade shall be brought up to the lines and grades required and if it is not to be stabilized, it shall be compacted to 95-percent of standard proctor density, (ASTM Method D698), using a moisture content ranging from optimum to plus 3-percent above optimum. The subgrade, without stabilization, shall be compacted to a depth of 9-inches. The subgrade shall be kept free from all ruts and weak spots. Any ruts and weak spots that develop under traffic shall be repaired with suitable material as they develop.

3.7 COMPACTION

- A. All fill material shall be placed in uniform layers, dried or moistened as required to obtain approximate optimum moisture content and rolled to a density of at least 95 percent of maximum density at optimum moisture as determined by ASTM D-698. Compaction equipment shall be as hereinafter specified. The maximum thickness of uniform layers (loose measurements) shall be as follows:
 - 1. If the Contractor elects to use a pneumatic tired roller, the thickness of each uniform layer shall not exceed six (6) inches.
 - 2. If the Contractor elects to use sheepfoot rollers, the thickness of each uniform layer shall not exceed eight (8) inches.
 - 3. In locations where it is impractical to use the roller equipment, mechanical hand tampers will be used, and the thickness of each uniform layer shall not exceed four (4) inches. The method used to secure the optimum moisture content will be the Contractor's responsibility. The compacting equipment and the method of compaction shall be such that a uniform density will be obtained over the entire area and depth of material being compacted. All fill material deposited in place by means of scrapers, dump trucks, draglines or other similar equipment shall be thoroughly broken up before being spread into the uniform layers. Rolling shall start longitudinally at the sides and proceed toward the center of the crowned sections or start longitudinally at the low side and proceed toward the high side of sloped areas, overlapping on successive trips by at least one-half (1/2) the width of the roller unit. Alternate trips of the roller shall be slightly different in length.
- B. Excess loss of moisture shall be construed to exist when the soil moisture content is three (3) percent less than optimum moisture.
- C. An independent qualified Testing Laboratory either selected by or approved by the Owner or Engineer, for every 500 square yards of the compacted subgrade shall take density tests. The Testing Laboratory will furnish written reports covering results of all tests and inspections made. Reports will be made promptly to the Engineer, Contractor and Owner.

3.8 FINISH GRADING

- A. Uniformly smooth grade all areas indicated on the drawings to be graded. The finish surface shall be not more than 0.05 feet above or below the established grade or approved cross section. All ditches and swales shall be properly graded so as to drain readily. Where existing grade is disturbed by the Contractor in areas not marked to be graded, the Contractor will regrade the disturbed area to its original grade at no additional expense to the Owner.

END OF SECTION 31 20 00

SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall govern for all excavation required for the construction of sewers, sewer structures, pipe culverts, appurtenances and connections and for the backfilling around completed sewers to the level of the original ground, all in conformity with the locations, lines and grades shown on the plans or as given by the Engineer and in accordance with these specifications. This Section shall also govern for any necessary pumping or bailing and drainage and all sheathing and bracing of trench walls. Also governed by this Section are the cutting and restoration of pavement and base courses, the furnishing and placing of cement stabilized backfill, the hauling and disposing of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access as provided herein.

1.2 QUALITY ASSURANCE

- A. The Testing Laboratory's representative will determine the moisture density relationship in accordance with ASTM D698 on material secured from the trench excavation. Samples secured from the cement stabilized sand supplier shall be blended with Portland cement in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill, and the moisture density relationship will be determined in accordance with ASTM D558.
- B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least one test for each 200 linear feet of trench per lift of backfill.
- C. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, all segments shall be video tape recorded and tapes shall be furnished to the owner.

1.3 REQUIRED INSPECTIONS

- A. The contractor is solely responsible for meeting with all inspecting authorities having jurisdiction over the project (to include, but not limited to: Water District, City, County, State and Federal) prior to construction. All required inspections shall be coordinated by the contractor prior to installation of the WORK. All WORK found to be deficient by the inspector(s) and WORK installed prior to notification of inspector(s) shall be removed and replaced at the contractor's sole expense.

PART 2 – PRODUCTS

2.1 CONNECTIONS TO BUILDING GRAVITY SEWERS

- A. Connections to building gravity sewers, to include roof drains and sanitary sewer connections shall be made with SCH 40 X SDR adapter couplings.
- B. Fernco couplers are not allowed.

PART 3 – EXECUTION

3.1 EXCAVATION & TRENCH PREPARATION

- A. Excavate trench to the alignment and depth required. Brace the trench and drain, as required, so that the work may be accomplished safely and efficiently. If necessary, install a dewatering system to provide a dry trench bottom. Pumps shall discharge into natural drainage channels or to drains. Shoring for excavations and trenches shall meet the requirements of the latest edition of OSHA Regulation 1926, Subpart P.
- B. For pipes less than 30 inches in diameter, the minimum width of the trench shall be the width of the outside barrel of the pipe plus 24 inches, the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches. For pipe 30 inches and larger, the minimum trench width shall be the width of the outside barrel of the pipe plus 32 inches, and the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches.
- C. Side sloping or benching of the trench, where permitted, will begin at one foot above the top of the pipe and will not encroach upon private property or endanger existing or future structures or underground utilities. Depth of trench, without sheathing or bracing shall comply with OSHA Regulation 1926.650.
- D. The full width of the trench shall be excavated to a depth below the invert elevation of the pipe so as to permit placing the bedding material specified on the attached drawings below the outside bottom of the pipe. Any additional depth excavated by the Contractor shall be replaced with an equal depth of cement-stabilized sand. The cost of this additional material, in place shall be at the expense of the Contractor.
- E. Where necessary, excavations shall have sheathing and bracing to prevent caving. At these locations, increase the trench width as required and leave the sheathing in place until the pipe has been laid and the backfill compacted to a depth of 2 feet over the pipe. All sheathing and bracing shall be designed to the requirements of OSHA Standard 1926, Subpart P (latest edition).
- F. Sewers shall not be constructed, or sewer pipe laid in the presence of water. All water shall be removed from the excavation sufficiently prior to the sewer placing operation to ensure a dry, firm bed on which to place the sewer and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point system as conditions warrant. There will be no separate pay for well pointing without the prior approval of the Engineer. Contractor shall include in base proposal all costs associated with de-watering, well pointing, stabilizing, etc. necessary to install all underground utilities.
- G. In the event that the excavation cannot be dewatered to the point where the pipe subgrade is free of mud, excessive wet soil, sand silt or clay with water, a seal slab shall be used in the bottom of the excavation. Such seal slab shall consist of a lean concrete mixture. The seal slab shall be a Class "D", 5 sacks of cement per cubic yard with a minimum compressive strength of 1,750 P.S.I. at 7 days and 2,500 P.S.I. at 28 days. A precast seal slab may be used, provided that the joints of the seal slab do not occur at the joint of the pipe. Contractor shall have an option of using a three-day cylinder break test at no expense to the Owner.
- H. For unstable conditions requiring outside forms, seals, sheathing, and bracing, or where groundwater is encountered, any additional excavation in width and backfill required shall be done at the Contractor's expense. Portable trench boxes may be used in lieu of sheathing upon approval in writing by the Engineer. The trench box must be in accordance with OSHA Regulation 1926.650 (latest edition).
- I. Use of the trench box does not relieve the Contractor of any liability for damages to person or property. When a trench box is moved, the jointed pipe or in-place backfill shall not be disturbed.

- J. All materials from excavation operations not required for backfilling, if considered suitable shall be placed in embankments or wasted, in accordance with Section 31 20 00 - Earthwork. All material not suitable for use in embankments will be declared surplus by the Engineer and shall become the responsibility of the Contractor to dispose of as he wishes. Such surplus material shall be promptly removed from the work following the completion of the portion of the sewer involved. No separate payment shall be made for disposal of this surplus material.
- K. Unless otherwise specifically approved, Contractor shall use ladder or wheel-type trench-digging machinery, except where hand methods must be employed to avoid damage to existing structures above or below ground, or where hand excavation is indicated.
- L. Engineer may limit the amount of trench opened or partially opened at any time in advance of the completed pipe laying operation and the amount of trench left unfilled. Open no more than 500 feet of trench at any one time.

3.2 PIPE LAYING

- A. No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work, unless specifically approved by the Engineer.
- B. Non-pressure concrete pipe shall be laid with the ends abutting and true to line and grade. Fit and lay the pipe to form a smooth and uniform invert. Laying of pipe shall commence at the lowest point, so that the spigot ends point in the direction of flow. Lay cast iron pipe on firm earthen foundation with bell ends facing the direction of laying.
- C. All other types of pipe shall be laid in accordance with the applicable provisions of this specification, in accordance with the Special Provisions preceding this Subsection, or with the manufacturer's recommendations.
- D. Cut cast iron pipe with wheel-type cutters or cold chisel. Flame cutting of cast iron pipe is not allowed. Make cuts in a neat and workmanlike manner without damage to pipe and so as to leave a smooth end at right angles to axis of pipe. Field cutting of Polyvinyl Chloride shall be in accordance with the pipe manufacturer's recommendations.
- E. Minor deflections may be obtained in pipe joints. Contractor must obtain approval when the degree of deflection is necessary to deflect from a straight line. Where necessary to make major deflections in concrete pipe, use sections of pipe with beveled ends for deflections not greater than five degrees. For deflections greater than five degrees, use fabricated fittings for concrete pressure pipe and use cast iron fittings for cast iron pipe.
- F. When the pipe laying operation is halted, seal the open end of the pipe with a temporary plug. Plug is to remain in place until the pipe laying operation re-commences. Standard plugs shall be inserted into bells of all dead-end pipe.
- G. All underground pipe shall have a 12-gauge metallic tracer wire running the full length of the pipe. Tracer wire shall be taped to the pipe at intervals not to exceed 15-feet using duct tape and terminate at each end above ground in a 2" PVC riser.
- H. Pipe shall be installed with the labels facing upward.
- I. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, contractor shall run video-camera through pipes and video-record each line segment in order to document proper installation.

3.3 BACKFILLING

- A. As soon as practicable after completion of laying and jointing of pipe, backfill the trench. Not more than 200 feet of the trench shall be left open after laying the pipe.
- B. Trenches shall be backfilled in accordance with drawing details and notes. Backfill material selected from sewer trench excavation, or obtained from other sources, shall be free from stones, which will interfere with compaction and free of large lumps, which will not break down readily under compaction. Do not use material excavated in large lumps which will not break down or which cannot be spread in loose layers. Material excavated by trenching machine will generally be suitable for use as backfill. Cement stabilized sand shall be in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill.
- C. When placing backfill in the trench simultaneously on both sides of the pipe for the full width of the trench, moisten if necessary and tamp in approximately 6-inch layers, thoroughly compacting under and on each side of the pipe to provide solid backing against the external surface of the pipe. Walking or working on the completed pipeline, except as necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to at least 12-inches over the top of the pipe.

3.4 RESTORATION OF SURFACES

- A. Replace or repair sidewalks, driveway culverts, inlets, curbing, gutters, shrubbery, trees, fences, sod and other like obstructions removed or disturbed, to the condition equivalent to that existing prior to commencement of this work. Use concrete having a compressive strength of not less than 3,000 psi in 28 days for the replacement of curbing, gutters, inlets and sidewalks.
- B. Use reasonable care in the removal and replacement of shrubbery and trees designated to be replaced at original locations. Where at all possible, ditch alignment will be such as to minimize this work. The restoration of asphalt-topped flexible base and concrete streets shall be as specified under other items of the specifications.

3.5 CLEAN-UP

- A. The Contractor shall remove from the site of the work and from public and private property temporary structures, rubbish, and waste materials, including excess excavated materials. The Contractor is responsible for disposing of all surplus earth. The pipe laying operation shall be temporarily suspended if the clean-up is falling behind as determined by the Engineer or Owner.

3.6 MEASUREMENT & PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 00

SECTION 31 23 23.13 - BANK SAND BACKFILL

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall consist of the furnishing, placing, manipulation, compacting and completing in-place, Bank Sand as a bedding and backfill material for water and sewer lines, as construction fill for certain excavation areas, as construction fill for ruts, holes and other similar conditions; as a fill material for project clean-up and as directed by the Engineer. Bank sand shall be in accordance with these specifications and in conformity with the lines, grades and cross-sections shown on the plans and as directed by the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Bank sand is to be free of organic matter, foreign material, clay balls, sticks, foreign objects and other objectionable material. Bank sand shall have a plasticity index less than three (3) and shall meet the following gradation: 100 percent passing a 3/8-inch sieve, 5 to 30 percent passing a No. 200 sieve. Prior to use, Contractor shall identify the source of the proposed bank sand for testing.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. After the water line, sewer line or other similar construction item, such as a trench, has been excavated and brought to grade, bank sand shall be furnished, placed, compacted complete in-place, either as bedding or backfill material, as shown on the plans, described in these specifications or as directed by the Engineer. After the trench or excavation has been brought to grade, the bank sand shall be placed and compacted as a bedding material, the construction item shall be placed and joined properly around and over that construction item as required and as shown on the plans, described in the specifications or directed by the Engineer. Bank sand shall be placed in layers not exceeding 8-inches. It shall be compacted with mechanical vibratory tamps to maximum dry density in accordance with ASTM Method D698 at a moisture content ranging from optimum to three percentage points above optimum. Water flooding will not be permitted.

3.2 TESTING

- A. The Testing Laboratory's representative will determine the moisture density relationship for each material proposed for use as backfill, in accordance with ASTM Method D698. In place density will be determined in accordance with ASTM Methods D2922 or D1556, and with each type of construction. For walls and trenches, determine the in-place density for each 200 feet of wall or trench, for each lift of fill placed.

3.3 MEASUREMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 23.13

SECTION 31 23 23.16 - CEMENT STABILIZED SAND BEDDING AND BACKFILL

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section specifies cement stabilized sand to be used for backfilling and bedding as called for on the drawings, in other parts of the specifications, or as directed by the Engineer.

1.2 PERFORMANCE

- A. The sand cement mixtures shall produce a minimum unconfined compressive strength of one hundred pounds per square inch (100 psi) in forty eight hours, when compacted to ninety five percent (95%) of Standard Proctor density (ASTM Method D558), without additional moisture control and when cured in plastic bags at a temperature of 73.4° F at plus or minus 3° F and tested in accordance with ASTM D1633.
- B. Random samples of the delivered product will be taken in the field at the direction of the Engineer and tested at the Owners expense.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Cement shall be Type I Portland cement conforming to ASTM C150. Sand shall be clean durable sand containing not more than the following:
 - 1. Deleterious Materials:
 - a. Clay lumps, when tested in accordance with ASTM C142 shall be less than 0.5 percent. Lightweight pieces, when tested in accordance with ASTM C123 shall be less than 5.0 percent. Organic impurities when tested in accordance with ASTM C40 shall not show a color darker than the standard color.
 - 2. The plasticity index shall be six (6) or less when tested in accordance with ASTM D4318.
 - 3. Sand shall be free of organic matter and deleterious substances and shall meet the following gradation requirement.

<u>Square Sieve Size</u>	<u>% Passing, By Weight</u>
3/8"	100%
No. 200	5 - 30%

- 4. Water shall be clean and clear, free of oils, acids, alkalis, organic matter or other deleterious substances and shall conform to the requirements of ASTM C1602.

2.2 SAND-CEMENT MIXTURE PRODUCT

- A. The mixture shall consist of not less than 1.5 sacks of Portland cement per cubic yard (1.1 sacks per ton) of material mixture as placed. The mixture shall contain sufficient water to hydrate the cement.
- B. The cement, sand and water shall be mixed in a pug mill type mixer, which meets the approval of the Engineer. It shall be mixed for a minimum period of two minutes per batch.

PART 3 – EXECUTION

3.1 APPLICATION

- A. The sand cement mixture shall be placed in maximum eight (8) inch thick lifts, loose measure, and thoroughly rodded and tamped around the pipe, boxes, structures, and paving sections. Placement and compaction shall be performed in a manner that will thoroughly fill all voids without placing undue strain on or displacement of the structure.
- B. Cement stabilized sand backfill below the top of sewers, manholes, inlets or other structures shall be placed equally along all sides of the structure. Cement stabilized sand backfill/bedding shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids in the areas described, hand operated tampers may be used.
- C. Materials not placed and compacted within four (4) hours after mixing shall be rejected. Do not place or compact sand-cement mixtures in standing or free water.
- D. Cement stabilized sand backfill/bedding that is placed in trench bottoms or all other locations between the tops of sewer lines to the bottom of the subgrade, shall be compacted to a minimum of ninety five percent (95%) of Standard Proctor Density (ASTM Method D558), and shall apply to all areas of construction within the limits of the project.
- E. In-place density tests shall be taken at each location, each day, to test the placement of bedding/backfill material as directed by the Engineer. In-place densities shall be determined in accordance with ASTM D6938 or ASTM D1556.

END OF SECTION 31 23 23.16

SECTION 31 41 00 - TRENCH SAFETY SYSTEM

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This item is for furnishing all labor and materials for installation and maintenance of a trench safety system.
- B. For any trench excavation in materials other than solid rock, greater than five (5) feet in depth, or where shown on the plans, the contractor shall provide a trench safety system. This trench safety system shall be in accordance with the appropriate requirements established in the Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Subpart P - "Excavations, Trenching and Shoring" (latest edition).

1.2 MEASUREMENT

- A. Measurement of the "Trench Safety System" for gravity pipelines and boxes and for pressure pipelines shall be made by the linear foot of trench measured along the centerline of the trench.

1.3 PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 31 41 00

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. Section 013200 "Construction Progress Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 015000 "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 3. Section 312000 "Earth Moving"
 - 4. Section 312319 "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system.
- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Other Informational Submittals:
 - 1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
 - 2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify all impacted parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is referenced elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Delete this article if Contractor selects temporary excavation support and protection. Revise materials if prescribing excavation support and protection system requirements.
- B. General: Provide materials that are either new or in serviceable condition.
- C. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock or roll-formed corner shape with continuous interlock.
- E. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.

2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 32 13 13 - CONCRETE PAVING

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

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete paving, including, but not limited to, parking lots, aprons, sidewalks, curbs, handicapped accessible ramps, approaches, and miscellaneous exterior concrete shown on drawings.
- B. Traffic lane and parking space paint striping, including, but not limited to, painting of curbs and stenciling of signs stipulating FIRE LANES, NO PARKING and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction.
- C. Precast concrete wheel stops and accessories are shown in the drawings.

1.2 QUALITY ASSURANCE

- A. Where standards or requirements of this Section are in conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. M-90
 - 2. M-213
- B. American Concrete Institute (ACI)
 - 1. 305, Hot Weather Concreting
 - 2. 306, Cold Weather Concreting
- C. ASTM International (ASTM)
 - 1. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 2. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 3. C33, Standard Specification for Concrete Aggregates
 - 4. C94, Standard Specification for Ready-Mixed Concrete
 - 5. C150, Standard Specification for Portland Cement
 - 6. C260, Standard Specification for Air-Entraining Admixtures for Concrete
 - 7. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 8. C494, Standard Specification for Chemical Admixtures for Concrete
 - 9. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 10. C920, Standard Specification for Elastomeric Joint Sealants
 - 11. C979, Standard Specification for Pigments for Integrally Colored Concrete
- D. Federal Specifications (FS)
 - 1. TT-S-00227E, Elastomeric Joint Sealants
 - 2. TT-P-1952B, Traffic and Airfield Marking Paint, Water Emulsion Base

1.5 PROJECT CONDITIONS

- A. Do not place concrete in contact with frozen earth. Do not commence concrete placement unless the temperature is at least 35 degrees F and rising, or slabs until the temperature rises above 40 degrees F.
- B. Discontinue concrete placement when air temperatures exceed 100 degrees F.
- C. Dispose of any concrete that exceeds 95 degrees F as determined by the construction management personnel in the field.
- D. Do not place concrete during rain.
- E. Cold Weather Placing: Comply with ACI 306 to protect all concrete work from physical damage and reduce strength caused by frost, freezing actions, or low temperatures. Place no concrete against frozen earth.
- F. Hot Weather Placing: Prepare aggregates, mix water and other ingredients, and place, cure, and protect concrete according to the requirements of ACI 305.
- G. Do not apply traffic or zone marking paint on wet or damp surfaces or when rain is imminent. Do not commence painting operations until material, air, and/or surface temperature and dew point are within the paint manufacturer's recommended application limits.

1.6 TESTS AND INSPECTIONS

- A. Before starting any work under this section, make all required arrangements with the testing agency. Provide testing laboratory with certified reports on proposed cement, aggregates mixing water, and admixtures.
- B. Lab shall review design mixes for each type of concrete using previously tested and approved materials.
- C. The testing lab will proportion mixes by laboratory trial batch, using materials to be employed in the work for each class of concrete required and reporting to the Architect.
 - 1. Concrete Compression Test - 7-day and 28-day
 - 2. Concrete Slump Test
 - 3. Concrete Air Content
- D. Furnish certified reports of the format shown herein of each proposed mix for each type of concrete at least 30 days prior to the start of installation of the Work of this Section.
- E. Furnish ready mix delivery tickets to the field personnel upon request.

1.7 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for concrete admixtures.
- B. Shop Drawings: Show locations and installation procedures. Include details of joints, accessories, reinforcement, and clearances. Include a concrete placement sequence schedule.
- C. Concrete Design Mix Reports:
 - 1. One (1) for each type of concrete to be used.
- D. Submit product data and shop drawings for ALL items to be installed.

- E. Refer to Section 01 33 00 for submittal procedures.

1.8 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination
- B. Required Participants:
 - 1. General Contractor Superintendent
 - 2. Placement and Finishing Foreman
 - 3. Concrete Supplier
 - 4. Testing Lab

1.9 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years of experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 33 00, Submittals to be considered prior to proposal.

2.2 MATERIALS

- A. Formwork:
 - 1. General: Contractor may use any of the following formwork materials if material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
 - a. Wood Forms:
 - 1) Plywood: PS 1, Douglas Fir or Spruce species.
 - 2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
 - 3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.
 - b. Prefabricated Forms:
 - 1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Metal Reinforcement:
 - 1. Bars:
 - a. Conform to ACI 315, latest edition.
 - b. Comply with ASTM A615, Grade 60, deformed billet steel bars, unfinished, except Number 3 bars shall comply with ASTM A615, Grade 40, deformed billet steel bars, unfinished.
 - 2. Tie Wire: 16 gauge annealed.
- C. Concrete Materials (Other than concrete for extruded curbs, unless noted otherwise)

1. Cement: Type 1, ASTM C150, unless approved otherwise by Architect. Use one (1) brand of cement for entire project.
 2. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturer and used in compliance with manufacturer's recommendations.
 - a. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures. Provide one (1) of the following, or Architect approved equal:
 - 1) Eucon AEA-92 and Eucon Air Mix 200 by The Euclid Chemical Company.
 - 2) Sika AEA 14 by Sika Corp.
 - 3) MasterAir AE or MasterAir VR by BASF Admixtures.
 - b. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
 - 1) Eucon WR 75 or Eucon WR 91 by The Euclid Chemical Company.
 - 2) Master Pozzoloth 322 by BASF Admixtures.
 - 3) Plastocrete 161 by Sika Corp.
 - c. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or Type G and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
 - 1) Eucon 37 by The Euclid Chemical Company.
 - 2) ViscoCrete by Sika Corp.
 - 3) Master Rheobuild 1000 by BASF Admixtures.
 3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
 4. Integral Color Pigment (Required for new concrete handicapped accessibility ramps): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide one (1) of the following, or Architect approved equal:
 - a. ChemSystems, Inc.
 - b. Davis Colors
 - c. New Riverside Ochre Co., Inc.
 - d. Scofield Decorative Concrete by Sika Corp.
 5. Color Stain (Required for existing concrete handicapped accessibility ramps): A penetrating acrylic concrete stain, designed for adding color to existing concrete. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide H & C Silicone Acrylic Concrete Stain manufactured by Sherwin Williams, or Architect approved equal.
 6. Aggregates:
 - a. Comply with ASTM C33
 - b. Maximum size not larger than 1/5 of narrowest dimension between forms of the member for which concrete is to be used. Not larger than 3/4 of minimum clear spacing between reinforcing bars.
 - c. 1-1/2 inch maximum in paving slabs.
 7. Strengths:
 - a. Five and a half (5.5) sack (shall contain no less than 5.5 sacks of Portland cement)/3,500 psi/28 days.
 - b. Strength recommendations on Drawings supersede when they are greater than specified here.
 8. Water: Drinking quality.
 9. Water - Cement Ratio (lb water per lb of Portland cement):
 - 1) 0.52 Maximum
 10. Slump:
 - a. Slump shall be 4 inches plus or minus 1 inch, unless specifically noted otherwise.
- D. Joints:
1. Construction Joints and Expansion Joints: Refer to Paragraph on Accessories below.

2. Tooled Control Joint: Scored 1/4-inch wide x 1/4 thickness of concrete in depth.
- E. Accessories:
1. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height directly on properly prepared and compacted subgrade. No sand cushion pads will be permitted. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Dayton Superior, MEDCO PC-4 by Meadow Burke, a CHR Company, GTI Bar Chair by General Technologies, Inc., or approved equivalent. Maximum spacing of chairs shall be 36-inches on center each way.
 2. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture.
 3. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
 4. Epoxy Adhesive: ASTM C881, two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following, or approved equal:
 - a. Euco #452 Epoxy System or Euco #620 Epoxy System by The Euclid Chemical Company.
 - b. Sikadur Hi-Mod by Sika Corp.
 5. Expansion Joints:
 - a. Fiber Joint Filler: Pre-molded asphalt impregnated rigid fiber board. Comply with AASHTO M-213. Use 3/4-inch-thick at expansion joints adjacent to extruded curbs, 1/2-inch-thick at perimeter of footings for ground-set items such as bollards and fence posts where such footings are incorporated into slabs; elsewhere as shown.
 - b. Wood Expansion Joints: Where indicated in the drawing provide construction clear heart grade redwood joints conforming to AASHTO M-90. Provide sizes indicated on drawings. Do not install adjacent to curbs.
 - c. Joint Sealant: Shall be a self-leveling silicone base, cold-applied joint sealing compound complying with DOWSIL 890-SL Silicone Joint Sealant as manufactured by Dow Silicones Corporation or approved equal.
 6. Load Transfer Units:
 - a. Light Duty (sidewalk): 3/4 inch thick clear heart redwood expansion joint form with minimum one (1) inch deep removable top strip, 1/2 inch x 10 inch smooth steel reinforcing bars at 12 inches on center +/- with bond breaker sleeve on one (1) side, and 3/32 inch thick steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
 - b. Medium Duty (Auto) / Heavy Duty (truck/bus traffic): 3/4 inch thick redwood expansion joint form with minimum one (1) inch deep removable top strip, 3/4 inch by 18 inch steel reinforcing bars at 12 inches on center +/- with bond-breaker sleeve on one (1) side and 3/16 inch steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
- F. Curing Compound: The compound shall conform to ASTM C309-1315, Type II (A.I.M. Regulations - VOC Compliant). Provide 1600 White by W. R. Meadows, Inc., or equal products by BASF Admixtures, Dayton Superior, or approved equal.
- G. Other Materials: Provide all items required to complete work which is not specified, or which is not to be provided by other trades.
- H. Extruded Concrete Curbs:
1. Materials:
 - a. Portland Cement: ASTM C150, Type I.
 - b. Aggregate: ASTM C33.
 - c. Water: Clean, free of contaminating material.
 2. Epoxy Adhesive: As specified under concrete materials above.

3. Concrete Mixing:
 - a. Slump: No slump allowed.
 4. Curing Compound: As specified under concrete materials above.
- I. Traffic and Zone Marking Paint: (As shown on drawings or required)
1. Type: chlorinated rubber paint conforming to the requirements of TT-P-115E. Sherwin Williams product Setfast Chlorinated Rubber Zone Marking Paint TM5126 – White and TM5127 – Yellow or approved equal.
 2. Stripe Size: Four (4) inches wide for traffic and parking lanes, unless noted otherwise.
 3. Colors:
 - a. Traffic and Parking Striping / crosswalks, directional arrows: White or as selected by Architect.
 - b. Fire Lanes: All curbs at driveways adjacent to building shall be painted solid red with white stenciled lettering to read “FIRE LANE, NO PARKING” in size and spacing required by authorities having jurisdiction. Contractor to verify requirements of local jurisdiction for fire lane striping.
 - c. Accessibility Handicapped Parking: Symbols and spaces shall be in size and color in accordance with ADA and TAS authorities having jurisdiction.
- J. Precast Concrete Wheel Stops: (As shown on drawings or required)
1. **Precast of 3,000 psi air-entrained concrete, approximately 9.5 inches high x 12 inches wide x 8 feet-0 inches long, with chamfered top corners and drainage slots underneath for buses (please refer to plans). Unit shall weigh minimum 800 lbs.**
 2. **Precast of 3,000 psi air-entrained concrete, approximately 6 inches high x 9 inches wide x 6 feet-0 inches long, with chamfered top corners and drainage slots underneath for vehicles (please refer to plans). Unit shall weigh minimum 190 lbs.**
 3. Anchor Rods: Two (2) No. 4 by 12-inch-long anchor rods located approximately 12 inches from each end of wheel stop.
 4. Epoxy Adhesive: As specified under concrete materials above.
- K. ADA Detectable Warning Paver
1. As produced by Pavestone or approved Equal.
 2. Color as approved by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review approved mix designs with Architect in field.
- B. Clean all mixing and transportation equipment; remove debris from forms; wet forms thoroughly; remove ice and other coatings from reinforcement which might hinder good bond; remove water from place of deposit; and check reinforcement.
- C. Inspection: Examine all areas and conditions under which the Work of this Section will be performed. Correct any conditions detrimental to the approved completion of the work. Do not proceed until all such conditions are corrected.
- D. If thickness of concrete pavement is not labeled on the drawings, the thickness shall be 6-inch thick.

3.2 INSTALLATION

- A. Forms:
 1. Conform to the shapes, lines and dimensions of the members as shown on the drawings, except as modified under the Earthwork Section of these specifications. Review depths with Architect in field.

2. Care shall be taken to assure that formwork does not stain concrete surfaces.
 3. Slab Block-Outs:
 - a. Diamond configuration at paving drains, round or diamond configuration at bollards, fence posts and the like.
 - b. Coordinate with concrete joints, verify with Architect.
 4. Slope exterior concrete slabs away from building and towards paving drains. Verify all slopes with Architect prior to start of concrete pour.
 5. Form Removal:
 - a. Remove only after concrete has thoroughly hardened.
 - b. Vertical forms for ground-supported slabs may be removed 24 hours after pour.
- B. Reinforcing:
1. Cleaning Reinforcement: Free from rust, scale, dirt, or other coatings which will destroy or reduce the bond.
 2. Placing Reinforcement:
 - a. Place accurately and adequately secure in position.
 - b. Bar reinforcement in all concrete slabs shall be held in proper locations by use of plastic chairs spaced a maximum distance of 36 inches on center unless noted otherwise.
 3. Coverage of Reinforcement: The metal reinforcement shall be protected by the thickness of concrete indicated on the plans.
 - a. Three (3) inches: Concrete deposited against ground without use of forms.
 - b. Two (2) inches: Bars more than 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
 - c. 1-1/2 inches: Bars 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
 - d. Two (2) inches: In slabs and walks on grade.
 - e. 1-1/2 inches-1-3/4 inches from top: Paving
- C. Joints:
1. Construction Joints:
 - a. Shall occur at expansion joints.
 - b. Use at cold joints in paving slabs.
 2. Expansion Joints:
 - a. Locate fiber joint filler type where walks and paving abut curbs and at perimeter of slab infill. Joints shall be continuous and full depth and width of slab. Stop 3/4-inch-thick fillers 1/2 inch below top of paving and 1/2-inch-thick fillers 3/8 inch below top of paving for subsequent application of sealant cap; sealant to be applied to within 1/8 inch of slab surface. Verify other locations with Architect where asphalt impregnated fiber joint filler and sealant cap is to be used.
 - b. Locate redwood expansion joints at paving and walk expansion joints where indicated, complete with load transfer units as specified herein and detailed. Joints shall be continuous and full depth and width of slab. Except where detailed without sealant cap, stop expansion joints 1/2 inch below top of paving for subsequent application of sealant cap. Top surface of sealant shall be approximately 1/8 inch below top of adjacent concrete. Install sealant in accordance with manufacturer's instructions. For applications where no sealant cap is to be applied, stop expansion joints 1/8 inch below top of paving surface. Verify other locations with Architect where redwood expansion joint and sealer cap is to be used.
 - c. Install redwood expansion joints 5 feet either side of water lines under pavement.
 3. Load Transfer Units: Install straight and true, and in accordance with manufacturer's instructions.
 4. Tooled Joints:
 - a. Steel tool all control joints, edges of expansion joints, and all exposed perimeter edges to smooth bullnose, using an edger having a radius of 1/4 inch, as approved.

- b. Form control joints in uniform straight lines in locations indicated, but in no case greater than 5 feet apart, uniformly spaced.
- D. Accessories: Install accessories and boxes, sleeves and other required devices furnished by other trades.
- E. Concrete:
 - 1. Conveying:
 - a. Batching, mixing and Delivery Equipment: Use transit mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to the site in accordance with provision of ASTM C94.
 - b. Where colored concrete is shown or required, i.e. accessible ramps, use color pigment admixture in concrete. Mix color pigment into concrete in accordance with manufacturer's recommendations to achieve integrally pigmented concrete in specified colors or as selected by Architect.
 - c. Handling concrete from point of delivery and transfer to conveying equipment and to location of final deposit as rapidly as practicable and by methods which prevent segregation and loss of mix materials.
 - d. Provide runways for wheeled conveying equipment from delivery point to location of final deposit.
 - e. Keep interior surfaces of conveying equipment, including chutes and tremies, free from hardened concrete, debris, water and other deleterious materials.
 - f. Pumps may be used only if they can pump the mix designed. Do not add fine aggregate or water to the mix to satisfy needs of a pumping device.
 - g. Use chutes or tremies for placing concrete where a drop of more than 6'-0" is required.
 - h. Addition of water on the job - The maximum water-cement ratio should never be exceeded. If all the water allowed by the specification has not been added at the start of mixing, it may be permissible to add the remaining allowable water at the point of delivery.
 - 2. Concrete Placement, General:
 - a. Place concrete in compliance with practices and recommendations of ACI 304, and as specified herein.
 - b. Do not deposit concrete on concrete which has hardened sufficiently to form seams or planes of weakness within the section.
 - c. Sections between expansion joints shall be placed in continuous pours; construction joints in paving and walks other than at expansion joint locations will not be permitted.
 - d. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
 - e. Deposit concrete as nearly as practicable in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which might cause segregation.
 - f. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming and grouting.
 - g. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials.
 - 3. Slab Placement:
 - a. Moisten subgrade the evening before and immediately prior to placement of all paving slabs.
 - b. Deposit and consolidate concrete slabs in a continuous operation, within the limits of all expansion joints, until the placing of a panel or section is completed using vibrating bridge screeds, roller pipe screeds or other methods acceptable to Architect.

- c. Consolidate concrete during placement by use of the specified equipment, preferably with power driven floats of impact type, thoroughly working concrete around reinforcement and into corners.
 - d. Bring slab surfaces to correct level with a straight edge, and then strike off.
 - e. Use bull floats or darbies to smooth the surface, leaving it free from bumps and hollows.
 - f. Do not sprinkle water on the plastic surface; do not disturb the slab surfaces prior to start of finishing operations.
 - 4. Extruded Curb Placement:
 - a. Install to detail in locations shown.
 - b. Apply epoxy resin adhesive to paved surface prior to extruding curb.
 - c. Machine extrude concrete to shape detailed on Drawings, as approved. Trowel form concrete curbs in areas where machine cannot reach.
 - d. Install pre-molded expansion joints where curbs meet poured-in-place concrete and at 60 lineal feet maximum spacing; elsewhere where indicated.
 - e. Cut crack control joints every 20 lineal feet and at beginning of curves with less than five (5) foot radius.
 - f. Hand trowel rough areas to a dense, uniform texture. Bevel curbs 45 degrees at dead ends.
 - g. Spray apply membrane forming curing compound after curb installation.
 - h. Remove and replace curbs which crack; cut out chipped or cracked areas and reinstall new extruded curbs.
 - i. Remove excess concrete from paving surfaces.
- F. Curing:
 - 1. General:
 - a. Protect all freshly placed concrete from premature drying and excessive hot or cold temperature extremes. Start curing procedures on slabs immediately after finishing operation.
 - b. Maintain curing procedures for seven (7) days at minimum temperature of 50 degrees F.; if mean daily temperature drops below 40 degrees F. during this period, extend curing period an equal number of days or provide temporary heat or additional protection to maintain specified minimum temperature of air in contact with concrete.
 - 2. Curing Exterior Paving and Slabs: Spray paving, walks, curbs and other miscellaneous slabs with liquid membrane-forming compound specified above, applied at not less than the manufacturer's specified and recommended rate.
- G. Finishes:
 - 1. Spreading of dry cement for finishing is not permitted.
 - 2. Finish all exposed edges and joints with edging tools of 1/4 inch radius.
 - 3. Exterior Paving and Slabs:
 - a. Floating: Do not begin floating until bleed water sheen has disappeared or until leveled material has stiffened sufficiently for power floating. After power floating, re-float by hand immediately to uniform, true, smooth, granular surface within the specified tolerance.
 - b. Medium Broom Finish: Broom after floating and concrete is hard enough to retain scoring. Use a stiff fiber or wire broom. Broom perpendicular to direction of traffic, typically. Broom in opposite directions at sidewalk panels in a checkerboard pattern or as indicated on drawings.
 - 4. Handicapped Accessible Ramps: Slope surfaces as shown on drawings. Texture ramp by providing raised, truncated domes on the surface of the ramp in accordance with TAS.
 - 1) New Concrete Ramps: Integrally color concrete in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.

- 2) Existing Concrete Ramps: Stain concrete using specified concrete stain in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
 - a) Prior to applying any stain, existing concrete ramps shall be cleaned up of all dirt, oil, grease, and other contaminants.
 - b) Acid etch with 25 percent muriatic acid solution.
 - c) Power wash at 3,000 psi.
 - d) Water test to determine if water absorbs, thereby making it good to stain.
 - e) Allow concrete to thoroughly dry.
 - f) Apply stain in accordance with manufacturer's instructions.

Note: All colors must be approved by Architect prior to their use. Failure to do so, may be cause for rejection of work and removal and replacement of work with new work at Contractor's expense.

5. Miscellaneous Vertical Surfaces: Finish all vertical surfaces, including but not limited to curbs, risers, low walls and stringer, while concrete is strong enough to stay in place without forms yet green and able to be finished to a homogeneous appearance.
- H. Traffic Lane, Parking Space, and Zone Paint Striping: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect paint bond.
 2. Allow concrete surfaces to cure the minimum time recommended by the traffic marking paint manufacturer, but in no case less than 30 days prior to applying traffic marking paint.
 3. Locate markings as indicated on drawings. Do not apply paint until layout is verified with Architect. Protect surfaces which are not to receive paint.
 4. Mix paint and apply in accordance with manufacturer's instructions, using skilled labor and proper mechanical equipment to produce uniform, straight lines without bleeding edges or runs.
 5. Paint traffic, parking lanes, and accessibility handicapped parking lines as shown on drawings and to comply with requirements of authorities having jurisdiction.
 6. Paint curbs and stenciled signs for FIRE LANES, NO PARKING, and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction. Use proper type, style and size stencils for all numbers and lettering. Do not apply paint until layout is verified with Architect and/or authorities having jurisdiction. Protect surfaces which are not to receive paint.
- I. Precast Concrete Wheel Stops: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect epoxy bond.
 2. Locate wheel stops as indicated on drawings.
 3. Predrill holes in concrete paving for anchor rods.
 4. Secure wheel stops in 1/8-inch-thick x 3-inch-wide epoxy and drive anchor rods through predrilled holes filled with epoxy grout.
- J. ADA Detectable Warning Paver
1. Install per manufacturer's details and requirements.

3.3 FIELD QUALITY CONTROL

- A. Inspection and Testing Laboratory:
1. Perform the appropriate tests upon notification by the Contractor.
- B. Tolerances:
1. Slope as shown on drawings.

2. Paving sections containing "bird baths" greater than two (2) feet in diameter or 1/8 inch deep (regardless of the size of the area) will be removed and re-poured at the Contractor's expense.

3.4 PATCHING AND CLEANING

- A. Clean exposed concrete surfaces and adjoining work stained by concrete leakage to the Architect's approval.
- B. Reinforce or replace all deficient work as directed by the Architect and at no additional cost to the Owner.
- C. Clean all concrete and cement work upon completing this portion of the work.

3.5 DEFECTIVE WORK

- A. Imperfect or damaged work, as determined by the engineer, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.6 PENALTY FOR DEFICIENT PAVEMENT THICKNESS

- A. It is the intent of this specification that the pavement be constructed in strict conformity with the thickness and typical sections shown on drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.
- B. Prior to final acceptance, and if deemed necessary by the Engineer, the pavement will be cored by the Testing Laboratory. Locations of core tests may be selected by the Engineer. Regular testing shall occur for every five hundred (500) square yards of placed concrete pavement and at random locations.
- C. For the purpose of establishing an adjusted price for pavement, units to be considered separately are defined as 500 square yards of pavement.
- D. One core will be taken at locations selected by the Engineer or at random in each unit and tested in accordance with ASTM Method C-174. When measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made.
- E. If the measurement of any core from any unit is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, two additional cores will be taken from the unit, and the average of the three cores will be determined. The two additional cores will be taken so that the unit will be well represented. If the average thickness of the three cores is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, an adjusted unit price as provided below, will be paid for in these areas represented by these cores. At the option of the Engineer, additional cores may be taken in the adjacent unit/units to determine if the deficiency of thickness continues across all lanes of pavement. If the deficiency exists in one (1) or more adjacent units, adjusted unit prices as provided below will be paid for those adjacent units that are found to be deficient.
- F. Price Adjustments: Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores (in inches)	Proportional Part of Contract Price Allowed (adjustment factor)
No deficient	1.0
Over 0.00 through 0.20	1.0

Over 0.20 through 0.30	0.80
Over 0.30 through 0.40	0.72
Over 0.40 through 0.50	0.68
Over 0.50	0.50 or removal*

*At the option of the Engineer.

- G. Any area of pavement found deficient in thickness by more than 0.50 inch but not more than 0.75 inch shall be evaluated by the Engineer. If, in the judgement of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings. Any area found deficient in thickness by more than 0.75 inch shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings.
- H. No additional payment over the contract price will be made for any pavement of a thickness exceeding that required on the drawings. Also, planing of concrete pavement shall not be allowed.

END OF SECTION 32 13 13

SECTION 32 16 13 - CONCRETE CURB, GUTTER, SIDEWALKS & DRIVEWAYS

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

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall govern for curb, gutter, combined curb and gutter, sidewalks and/or driveways, with or without reinforcing steel composed of Portland cement concrete constructed on approved subgrade, foundation material or finished surface in accordance with the lines and grades established by the Engineer and in conformance with the details shown on the plans. As used in this Section, the word "curb" refers to concrete curb, concrete gutter and combined concrete curb and gutter.

1.2 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Concrete used in conventionally formed and extruded construction shall be 3,500 psi (at 28 days) concrete having 5.5 sacks of cement per cubic yard and $\frac{3}{4}$ " coarse aggregate.
- B. Reinforcing steel, if required, shall conform to the requirements of Section 03210 - Reinforcing Steel.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. For conventionally formed concrete, the subgrade, foundation, or pavement surface shall be shaped to the line, grade and cross-section and if considered necessary by the Engineer, hand tamped and sprinkled. If dry, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon.
- B. Outside forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free of warp and of a depth equal to the depth required. They shall be securely staked to line and grade and maintained in a true position during the depositing of concrete. Inside forms for curbs shall be of approved material, shall be of such design as to provide the curb required and shall be rigidly attached to the outside forms. The reinforcing steel shall be placed in the position shown by the plans. Care shall be exercised to keep all steel in its proper location.
- C. After the concrete has been struck off and after it has become sufficiently set, the exposed surfaces shall be thoroughly worked with a float. The exposed edges shall be rounded using an edging tool to the radius indicated on the plans.
- D. Sidewalks shall be constructed in sections of the lengths shown on the plans. The different sections shall be separated by a board joint of the thickness shown on the plans, placed vertically and at right angles to the longitudinal axis of the sidewalk. Where the sidewalks or driveways abut a curb or retaining wall, approved expansion material shall be placed along their entire length. Similar expansion material shall be placed around all obstructions protruding through sidewalks or

driveways. Sidewalks shall be marked into separate sections, as shown on plans, using approved jointing tools.

- E. Curbs, gutters and curb and gutters shall be placed in sections of 45-foot maximum length unless otherwise shown on the plans. Joints shall be constructed at such locations and of the type as directed and specified on the plans.
- F. For extruded concrete construction, the concrete shall be placed by an extrusion machine approved by the Engineer. When placement is directly on subgrade or foundation materials the foundation shall be hand-tamped and sprinkled if considered necessary by the Engineer. If the concrete is placed directly on the surface material or pavement, such surface shall be thoroughly cleaned. If required by plan details, the cleaned surface shall then be coated with an approved or other coating as specified at the rate of application shown.
- G. The line shall be maintained from a guideline set by the Contractor. The outline shall strictly conform to the details shown on the plans. The forming tube of the extrusion machine shall be readily adjustable vertically, during the forward motion of the machine to provide variable heights necessary to conform to the established grade line. To provide a continued check on the grade, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the extruded work and the guideline. Other methods may be used if approved by the Engineer.
- H. The mix shall be fed into the machine in such a manner and at such consistency that the finished work will present a well compacted mass with a surface free from voids and honeycomb and true to the established shape, line and grade.
- I. Any additional surface finishing specified and/or required, shall be performed immediately after extrusion. Joints shall be constructed at such location as directed by the Engineer and to the details shown on the plans.
- J. When sidewalks are to be placed adjacent to a curb or a curb and gutter, the sidewalk and curb, or curb and gutter may be placed monolithically in one pass of the machine, provided the work is satisfactory to the Engineer.
- K. All concrete under this item shall contain 4% + 1-1/2% entrained air. The completed work shall be cured for not less than 72 hours.

END OF SECTION 32 16 13

SECTION 32 18 23.22.1 - NYLON SYNTHETIC TURF SYSTEM-PADDED

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

PART I – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. The work under this section shall consist of furnishing all labor, materials, and equipment necessary to install, in place, all synthetic turf and other materials as indicated on the plans and as specified herein. The installation of all new materials shall be performed in strict accordance with these specifications, the manufacturer's instructions and in accordance with all details and shop drawings.

1.3 SUBMITTALS

- A. Substitutions: Products other than those listed in Section 2.1.A. are acceptable if in compliance with all requirements of these specifications. Submit alternate products with the bid proposal and provide the following:
 - 1. Provide all specifications, product data, certification and required information for proposed alternate. It is the responsibility of the bidder to prove that the product substitution is equal to or greater than the product specified.
 - 2. Provide a 1' x 1' sample of the product substitution
- B. Product Data: For each type of product indicated.
 - 1. Submit manufacturer's catalog cuts, material safety data sheets (MSDS), brochures, specifications, preparation and installation instructions and recommendations
 - 2. All supplied and installed materials and products will meet or exceed the minimum specifications designated in this section. Sufficient data must be submitted to indicate compliance with the Contract Documents
 - 3. Submit instructions for installation.
- C. Test Results: The following test results, certified by a licensed independent testing laboratory, shall be submitted as outlined below
 - 1. With the bid – Mandatory and minimum specifications as shown in Part 2. Bids not meeting the minimum specifications will be rejected.
- D. Shop Drawings: Show fabrication and installation details for synthetic turf including, but not limited to:
 - 1. Proposed locations of all seams in fabric surfacing. Show installation methods and construction.

2. Field lining and marking - Submit a complete scale and dimensional drawing of tufted-in or painted field lines and marking boundaries. Include graphics for center logo artwork (if required) for approval as well.
 3. All submittals shall be provided within 14 days after Notice to Proceed
 - E. The Manufacturer / Installer shall provide the following samples of the artificial turf selected for this project
 1. A 12-inch x 12-inch minimum sample of the exact synthetic turf system that is specified for this project.
 - F. With the bid - Proof that the turf is manufactured in the United States of America. Foreign-made turf products are not allowed. Bids including foreign materials will be rejected.
 - G. With the bid – Sample Warranty: The Contractor shall provide a warranty to the Owner that covers defects in materials and installation workmanship of the turf for a period of eight (8) years from the date of substantial completion. The turf manufacturer must verify that their representative has inspected the installation and that the work conforms to the manufacturer's requirements and any written directives. The manufacturer's warranty shall include general wear and damage caused from UV degradation. Other items that must be addressed include the following:
 1. Acceptable uses for the field.
 2. Fading.
 3. Color match within specifications.
 4. Excessive fiber wear.
 5. Wrinkling and panel movement.
 6. Seam integrity.
 7. Drainage (through the turf only).
- Exclusions shall include the following:
1. Vandalism
 2. Acts of God beyond the control of the Owner or the Manufacturer
- H. Maintenance and Operations Data: At the completion of the project submit 3 complete sets, in manual form, of all the manufacturer's recommended procedures and materials for, but not limited to general maintenance, line/markings installation, small repair procedures, cleaning, etc...
- I. Project Record Documents: Record actual locations of seams, drains, and other pertinent information in accordance with the General Requirements

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications
 1. Shall own and operate its manufacturing plant in the United States. Plant must be capable of extruding its own nylon fiber for the system. Plant shall also be capable of tufting the fibers into the backing.
 2. Shall be experienced in the manufacture and installation of the specified type of synthetic turf for a minimum of five (5) years.
 3. Shall have its own, in-house laboratory where samples of turf are retained and analyzed. Tests shall be performed at all levels of production from the extrusion process to the

tufting process and through to the final stages before the turf is loaded onto the truck for delivery.

- B. **Installer Qualifications:** An authorized representative of the synthetic turf manufacturer for installation and maintenance is required for this Project.
 - 1. Installation team shall be an established, experienced in the field installer, with a minimum of two years of experience with 15 foot wide tufted nylon materials. Installer shall have installed a minimum of five (5) 100% glued down fields.
 - 2. Installation team shall be certified, in writing, by the turf manufacturer, as competent in the installation of the specified material, including seaming and proper installation of the pad, and gluing down the system
 - 3. Site superintendent shall have at least five (5) installations similar to this type.
- C. **Source Limitations:** Obtain synthetic turf through one source from a single manufacturer. Any Materials (including the fiber itself) manufactured outside of the United States are not acceptable.
- D. All components and their installation method shall be designed and manufactured for use on indoor or outdoor athletic fields. The materials as hereinafter specified, should be able to withstand full climatic exposure, be resistant to insect infestation, rot, fungus and mildew; to ultra-violet light and heat degradation, and shall have the basic characteristic of flow-through drainage allowing free movement of surface run-off through the turf and directly into prepared granular base and into the field drainage system.

1.5 PROJECT CONDITIONS

- A. **Weather Limitations:** Proceed with installation only when existing and forecasted weather conditions permit synthetic turf work to be performed according to Contractor/Manufacturer's written instructions and warranty requirements.
- B. **Field Measurements:** Indicate measurements on Shop Drawings.

1.6 MAINTENANCE SERVICE

- A. Turf Installation Contractor shall train maintenance staff and/or contracted maintenance staff in the use of the recommended maintenance equipment and provide maintenance guidelines to the facility maintenance staff.

PART TWO – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. **Pre-Approved manufacturers:**
 - 1. AstroTurf® (Puregrass)
 - 2. Alternate manufacturers are acceptable provided they meet and/or exceed all listed requirements, qualifications and specifications.

2.2 MATERIALS

- A. **Synthetic Turf System:** A complete synthetic turf system consisting of 100% in-house manufactured nylon fibers. Yarn cross-section shall be a nylon extruded diamond monofilament.

Pile height shall be nominal 1-1/4" Fibers shall be tufted into a single sports caliber fabric matrix and coated with a mechanically applied Biocel™ Polyurethane 5mm foam pad.

1. The carpets' primary backing shall be coated with an acrylic pre-coat and a 5mm Biocel™ Polyurethane foam pad weighing no less than 86 ounces per square yard.
 2. The carpet shall be delivered in 15' wide rolls. The rolls shall be of sufficient length to go from sideline to sideline. Head seams, other than at sidelines, will not be acceptable.
- B. The pile surface shall provide good traction in all types of weather with the use of conventional sneaker type shoes, composition mold sole athletic shoes, baseball spikes and screw-on football spikes.
- C. The pile surface shall be suitable for both temporary and permanent line markings using acrylic paint, as per the manufacturer's recommendations.
- D. Adhesive for gluing turf system to the base shall be a one part, high green strength urethane which exhibits high tenacity. Glue shall be Nordot 34D-2 as provided by Synthetic Surfaces, Inc., Scotch Plains, New Jersey, of preapproved equivalent.
- E. All glue for gluing seams shall be per manufacturer's recommendations.
- F. Perimeter edge details required for the system shall be as detailed and recommended by the manufacturer, and as approved by the manufacturer.

2.3 FABRIC SURFACE

- A. The pile surface shall resemble freshly mown natural grass in appearance, texture and color.
- B. The pile surface shall be nominally uniform in length.
- C. The entire system shall be resistant to weather, insects, rot, mildew and fungus growth and will be non-allergic and non-toxic.
- D. The synthetic turf system shall have a nominal fiber length of 1-1/4".
- E. Each roll shall be minimum 15' wide.
- F. All markings will be painted.

2.4 PRODUCT SPECIFICATIONS

- A. Yarn shall be proven athletic quality 100% nylon monofilament yarn designed specifically for indoor or outdoor use and stabilized to resist the effects of ultraviolet degradation, heat, foot traffic, water and airborne pollutants. Fiber MUST be extruded in-house. Fiber extruded by outside manufacturers shall not be acceptable. The fabric shall possess the following minimum physical characteristics. ASTM testing shall be provided with the bid and any products not meeting the minimum physical characteristics will be rejected:

Pile Yarn Type
Yarn Melting Point

Nylon extruded monofilament
>420 degrees F

Yarn Maximum Elongation	> 30% nominal
Pile Height	1-1/4"
Stitch Gauge	3/8"
Face Weight	56 oz. per square yard
Fabric Width	15'
Fabric Construction	Tufted
Pad	8mm Polyurethane Foam
Pill Burn Test	Pass

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for visual installation tolerances. Proceed with installation only after satisfactory conditions have been corrected.
- B. Certification of prior work: The synthetic turf manufacturer and / or installation contractor shall perform a visual inspection of the field base onto which the synthetic turf system is to be installed and to examine the finished surface for required grade tolerances. After any discrepancies between the required materials, application and tolerance requirements noted have been corrected, the synthetic turf installer should submit a written certification of VISUAL acceptance of the base for installation of the synthetic turf system. Any tests other than VISUAL tests shall be the responsibility of the General Contractor or Landscape Architect.
- C. Installation of all materials shall be performed in full compliance with approved project shop drawings. Only factory trained technicians skilled in the installation of athletic caliber synthetic turf systems, working under the direct supervision of the manufacturer's supervisors, shall undertake the placement of the turf system. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer as competent in the installation of these materials, including proper seaming for knitted systems.
- D. All designs, markings, layouts and materials shall conform to all currently applicable NCAA rules and other standards and/or FIH standards that may apply to this type of synthetic grass installation.

3.2 PREPARATION

- A. Inspect delivered field surface fabric and components immediately prior to installation. Any damaged or defective items shall be rejected. Installed artificial system shall be inspected for, but not limited to, the following:
 - 1. Uniformity of product and color
 - 2. Surface bubbles
 - 3. Field markings
 - 4. Field Edge installation
- B. Environmental Conditions: Weather conditions are important for the successful installation of the systems. No work under this section will proceed when:
 - 1. Ambient temperatures are below 45 degrees F.
 - 2. Material temperatures are below 45 degrees F.
 - 3. Surfaces are wet or damp
 - 4. Rain is imminent or falling.

5. Conditions exist or are imminent, which will be unsuitable to installation requirements of the systems specified herein. Humidity levels will be inside the limits recommended by the adhesive manufacturer to obtain optimum bonding characteristics of the surfaces.

3.3 INSTALLATION OF THE SYNTHETIC TURF SYSTEM

- A. The carpet rolls are to be glued directly onto the properly prepared base. Care is to be taken not to disturb the base.
- B. All seams shall be glued using adhesive as recommended by the turf manufacturer. All work shall be such that the seams shall remain as required for the duration of the warranty period at a minimum. Seams shall be flat, tight and permanent with no separation or fraying.
- C. The perimeter of the field shall be firmly secured to the edge anchors for the life of the warranty and in accordance to project details.

3.4 FIELD LINING AND MARKINGS

- A. General: A complete field "Lining, Marking and Field Boundary" system will be provided with the installation of the surfacing system specified herein. All markings shall be installed in accordance with prior approved project Shop Drawings.
- B. All markings will be painted.
- C. Striping layouts shall be accurately surveyed by the Contractor before painting of field markings

3.5 FINAL ACCEPTANCE

- A. Prior to final acceptance, the Contractor shall submit to the Owner three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and striping.
- B. The Contractor shall provide evidence that the turf can be plowed with conventional rubber bladed snow removal equipment.
- C. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes.

3.6 CLEANING

- A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items. All usable remnants of new material shall remain the property of the Owner. The Contractor shall keep the area clean throughout the project and clear of debris. Surfaces, recesses, enclosures, etc... shall be cleaned, as necessary, to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 32 18 23.22.1

SECTION 32 18 23.53 - TENNIS COURT SURFACING

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Providing all labor, materials and equipment required for:
 - 1. Selective demolition of designated existing surfaces
 - 2. Installation of court surfacing.
 - 3. Game line striping.

1.2 COORDINATION

- A. Cooperation by Contractor of Work of this Section with other trades is mandatory, so that all phases of work may be properly coordinated without delays or damage to parts of any work.
- B. Contractor shall timely furnish items, such as tennis net post ground sleeves, and other items to proper contractors for inclusion in their work.
- C. Coordinate protection of existing net posts and net to ensure that posts and net remain in existing condition and net is located at correct playing height.

1.3 SUBMITTALS

- A. Manufacturer's Technical Data: Indicate material specifications. Include application rates and installation procedures.
- B. Care and Maintenance Manual: Submit manufacturer's care and maintenance manual of the surface system and a list of product accessories or other items of service. Describe materials, devices, and procedures to be followed for use and maintenance of the surface system, including the cleaning, paint application and removal techniques. Include any precautions required to maintain warranty.
- C. Samples:
 - 1. Submit available colors for Architect's selection.
 - 2. Submit 12 inch by 12 inch sample of surface system in approved color.
 - 3. Do not start surfacing until Architect has approved sample for material and color.
- D. Warranty: Submit surface contractor and manufacturer's warranty for the surface system.

1.4 WEATHER CONDITIONS

- A. Place no primers, surfacing, or any other component of the surface system when the air temperature is below or above the manufacturer's recommended installation temperatures, or when inclement weather, or the possibility of inclement weather exists during installation and for a period 48 hours after installation, unless approved in writing by manufacturer.

1.5 QUALITY ASSURANCE

- A. Inspect court substrate for proper slope to ensure that finished court surface will slope one (1) inch per ten (10) linear feet. Advise Owner and Architect if existing conditions are found not in compliance with this requirement.
- B. Provide surfacing work by only one (1) manufacturer.
- C. Installer shall be licensed by the manufacturer and shall produce, upon request by the Architect, a copy of the licensing agreement, as well as a current chronological record of previous installations. Use only skilled workers experienced in the crafts involved and thoroughly familiar with the specified requirements. Insufficient experience may be cause for rejection.

1.6 DELIVERY AND STORAGE

- A. Deliver materials to project site in accordance with construction schedule and manufacturer's recommendations.
- B. Deliver components clearly identified with manufacturer's original labeling and otherwise marked to indicate location of work.
- C. Store materials in dry location, protected against damage.

1.7 WARRANTY

- A. Warranty the work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Delamination from substrate.
 - 2. Failure to meet specifications.
 - 3. Bubbling, blistering, fading, or wearing excessively.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

- A. Concrete patching material shall be patching cement conforming to "Day-Chem Perma Patch" manufactured by Dayton Superior Corporation, or Architect approved equal.

2.2 SURFACING SYSTEM

- A. Material: Provide and install a colored acrylic tennis court surfacing system, by Laykold (a subsidiary of Advanced Polymer technology Corporation), consisting of "Laykold Colorcoat Concentrate", ITF classified category 1 (slow pace), in color selected by Architect.
- B. Products/systems of the following alternate manufacturers, shall be considered an approved equal, subject to final approval by Owner and Architect:
 - 1. Plexipave, ITF classified category 1 (slow pace)
 - 2. Advantage Sports Coatings, ITF classified category 1 (slow pace)
- C. Approved Installers: (Any one (1) of the following):
 - 1. American Tennis Court Contractors, Inc., Fort Worth, Texas (817) 429-9200
 - 2. Australian Courtworks, Houston, Texas (713) 975-8552

3. Hellas Construction, Austin Texas
4. Tarkett Sports Construction, (479) 459-0468
5. Trans Texas Tennis, Inc., Houston, Texas (713) 691-1006
6. Strayhorn Tennis Court Construction, Austin, Texas (512) 836-1956

2.3 SEALANT

- A. Expansion Joints:
 1. Fiber Joint Filler: Existing joint material and conditions shall be inspected by Owner and Architect prior to installation of new surfacing. If repairs or replacement are required as a result of this inspection, contractor shall provide and install premolded asphalt impregnated rigid fiber board. Comply with AASHTO M-213. Use 1/2 inch thick at perimeter of footings for ground-set items such as bollards and fence posts where such footings are incorporated into slabs; elsewhere as shown or instructed by tennis court refinisher.
 2. Joint Sealant: Self-leveling silicone base, cold-applied joint sealing compound complying with No. 890-SL Self-Leveling Silicone Joint Sealant as manufactured by Dow Corning, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall survey the existing substrate surface to verify surface is flat to within 1/4 inch under a ten (10) feet straight edge in a direction perpendicular to the slope, and within 1/8 inch under a 10 foot straight edge in the direction of the slope.
- B. Examine substrate surface to ensure surface is adequate to be surfaced. Patch existing substrate(s) as recommended by surfacing system manufacturer to achieve best results of surfacing materials.

3.2 SURFACING

- A. Preparation:
 1. Surface to be coated must be sound, free from loose dirt or oily materials and be thoroughly cleaned prior to coating. Any loose residual coatings must be removed and any hard or smooth troweled surfaces must be sandblasted.
 2. Concrete must be cured at least eight (8) weeks before coating. If patching cement is used, it must be cured in accordance with manufacturer's recommendations before coating. Use moisture curing only. Use no chemical curing in surfaces to be coated.
 3. Etch concrete surfaces, as required, by uniformly brooming a ten (10) percent to 20 percent solution phosphoric acid (approximately six (6) parts water to one (1) part acid). Apply the diluted acid at a rate of 20 gallons per 1,000 square feet. Allow the acid to react until the bubbling ceases. Thoroughly flush the entire etching area and rinse with clean water, removing all residue. Repeat if unexposed aggregate remains.
- B. Once the surface has been thoroughly cleaned and is free of all loose material, dirt or dust, the court should be flooded and allowed to drain a minimum of 30 minutes and a maximum of 1 hour. Any area that holds water (birdbaths) in a depth greater than 1/16 inch (1.6 mm of thickness of a nickel) shall be outlined or patched.
- C. Surface Leveling: birdbaths shall be leveled using a LAYKOLD Acrylic Deep Patch court patch binder slurry. Prime area with a 50/50 mixture of LAYKOLD Acrylic Deep Patch and water. Primer shall be brushed into the place and allowed to dry prior to patching. Patch mix shall consist of LAYKOLD Acrylic Deep Patch, 50-mesh sand and Portland Cement. Mix as per manufacturer directions.

- D. Prime Coat:
1. Apply at the rate of approximately four (4) gallons of diluted materials per 1,000 square feet. Use Colorcoat 100 mixed two (2) parts to one (1) part water or Colorcoat Concentrate mixed one (1) to three (3) with water. Allow to thoroughly dry before applying the finish course.
- E. Crack Filling:
1. Cracks shall be cleaned, primed, and filled using LAYKOLD Acrylic Resurfacer if cracks are 1/16 inch or less. If greater than 1/16 inch, LAYKOLD Acrylic Deep Patch court patch binder slurry should be used to fill cracks. All areas that are repaired/leveled/corrected using a court patch binder mixture shall be allowed to fully cure and then ground smooth and level with the substrate by stone or an acceptable mechanical method.
- F. Acrylic Resurfacer: Apply one coat of LAYKOLD Acrylic Resurfacer using a 24", 30", or 36" wide 70 Durometer flexible rubber squeegee. Batch mix shall consist of 55 gallons of LAYKOLD Acrylic Resurfacer, 30 to 40 gallons (115 to 130 kg) of potable water, and 600 to 900 pounds (270- 400 kg) of clean, bagged silica sand (60 to 80 mesh). The application rate shall be 0.05 to 0.07 gal/yd² (0.29 – 0.40 kg/m² – 129-180 ft²/gal) of undiluted LAYKOLD Acrylic Resurfacer per coat. NOTE: If the asphalt is very porous, an optional 2nd application of LAYKOLD Acrylic Resurfacer may be applied. Each coat should be completely dry before applying subsequent coats.
- G. Textured ColorCoats: Apply 2 coats of LAYKOLD ColorCoat Concentrate textured batch mixture using a 24", 30" or 36" 50 Durometer flexible rubber squeegee. Batch mix shall consist of 55 gallons (260 kg) of ColorCoat Concentrate, 25 to 35 gallons (95 – 115 kg) of potable water and 300 to 450 pounds (135-203 kg) of clean, bagged silica sand (70 to 100 mesh). The application rate shall be 0.04 – 0.05 gal/yd² (0.23 – 0.29 kg/m² – 180-225 ft²/gal) of undiluted ColorCoat Concentrate per coat. Each coat should be completely dry before applying subsequent coats.
- H. Finish ColorCoat: Apply LAYKOLD ColorCoat Concentrate finish batch mixture using a 24", 30" or 36" 50 Durometer flexible squeegee. Batch mix shall consist of 55 gallons (260 kg) of ColorCoat Concentrate and 55 gallons (210 kg) of potable water. Each coat should be completely dry before applying subsequent coats. Allow topcoat to cure a minimum of 24 hours before applying game lines.
1. The finish course(s) shall not be applied until the underlying surface is completely dry.
 2. Colorcoat concentrate shall be applied at the rate of at least 12 gallons undiluted material per 1,000 square feet (0.11 gal. per sq. yard, 0.5 liters per sq. meter) in at least three (3) coats. The first two (2) coats shall contain sand, #70-90 mesh. Use round sand only. Final coat shall not have any sand.
 3. Maximum allowable addition of sand and water to the concentrate is 9 pounds of sand and 2/3 gallon of water to one (1) gallon concentrate. The maximum allowable dilution with water only is one (1) part water to one (1) part concentrate.
 4. The finished surface shall have a uniform appearance and be free of ridges, valleys and tool marks. After flooding with water, surface shall hold no "bird baths" deeper than 1/16 inch.
 5. No parts of the construction involving Laykold materials shall be conducted during rainfall or when rainfall is imminent, or unless the air temperature is at least 50 degrees F. (10 degrees C) and rising.
- I. Game Lines: Apply 1 to 2 coats as needed of LAYKOLD Textured White Line Paint with a brush or roller.
1. Wait a minimum of 24 hours after Finish ColorCoat before applying line paint.
 2. All lines are to be applied by painting between masking tape with a paintbrush or roller according to U.S.T.A. and A.S.B.A. specifications.
 3. Prime masked lines with LAYKOLD Line Prime and allow a minimum of 1 hour dry time.
 4. Remove masking tape immediately after lines are dry.

3.3 NET POSTS AND NETS

- A. After surfacing operations are complete, ensure that existing net posts are set to correct height to support top of net at 39 inches above court surface.

3.4 STRIPING (GAME LINES)

- A. After all Colorcoats are completely dry, apply two (2) inch wide game lines accurately located, marked and painted with Laykold Line Paint, white color.

END OF SECTION 32 18 23.53

SECTION 32 31 13.34 - BACKSTOP SCREENING (NYLON)

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

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide netting and suspension members for protective screening of the above-referenced project.

1.2 SUBMITTALS

- A. Product data and installation drawings.
- B. Evidence of compliance with Article 1.02 shall include a list of at least five projects of a similar nature in Texas, including name and contact information for Architect or Contractor, and Owner.

1.3 QUALITY ASSURANCE

- A. Work of this section shall be performed by a firm with a minimum of five years of experience in installing sports netting.

PART 2 – PRODUCTS

2.1 SUPPLIER

- A. Nets of Texas, Houston Texas, (281) 541-2766 or approved substitution.

2.2 COMPONENTS

- A. Netting. 1-5/8-inch square mesh, #36 knotted black nylon, 380 lb. tensile strength, double treated for UV protection, in longest practical lengths to limit the number of splices.
- B. Rope and Twine. Pre-shrunk black nylon treated for UV protection; 3/8-inch diameter rope with 2,500 lb tensile strength; #48 twine with 380 lb tensile strength.
- C. Hardware. Stainless Steel 3/8-inch aircraft cable with 15,000 lb tensile strength. Cable clips, Shackles, eyebolts, turn-buckles, etc. shall be galvanized.
- D. Support Poles. Hot dipped galvanized steel poles engineered to support net and deflection caused by tensioned cable. Netting shall be 50' above grade for Baseball and 40' above grade for Softball.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install net tight, without sags or puckering.
- B. Sharp edges and burrs on the cable will not be acceptable.
- C. Inspect work to ensure that balls cannot fit between the edge of the net and adjacent surfaces.

END OF SECTION 32 31 13.34

SECTION 32 31 19 – WROUGHT IRON FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Steel ornamental fences with solid steel pickets.
 - 2. Pedestrian gates.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for filling and for grading work.
 - 2. Division 3 Section "Cast-in-Place Concrete" for concrete post footings.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

- A. Submit product data in the form of manufacturer's technical data, specifications, and installation instructions for fences and gates.
- B. Shop Drawings: Submit shop drawings showing location of fence and gates, including each post, details of post installation, hardware, and accessories. Show sizes and thicknesses of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work, and other pertinent details of fabrication and installation.
- C. Samples for Verification: Submit samples for each profile and pattern of fabricated metal and for each type of metal finish required, prepared on metal of same thickness and alloy indicated for the Work. Include samples of the following:
 - 1. Post cap including 12 inch (300-mm) long section of post.
 - 2. Full-size sample of fence, 2 feet wide by full height.
 - 3. Gate hardware including hinges and latch.
- D. Qualification Data: Submit qualification data for fabricator.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for installation of ornamental metal fences and gates specified in this Section by the same firm that fabricated it.
- B. Fabricator Qualifications: A firm experienced in producing ornamental metal fences and gates similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.6 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.7 WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCT

2.1 MANUFACTURER

- A. Provide ornamental metal fences and gates as manufactured by Montage II – Heavy Industrial Steel Ornamental Fence System as manufactured by Ameristar Fence Products, Inc. (918) 835-0898 or comparable product approved by the Architect.

2.2 MATERIALS

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.

- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION, GENERAL

- A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
 - 1. Color: Architect to select from manufacturer's full range.
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.
- G. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fences and gates in accordance with approved shop drawings. Do not begin installation and erection before final grading is established.

- B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
 1. If not indicated on Drawings, excavate holes for each post 6 to 8 inches in diameter.
 2. Unless otherwise indicated, excavate hole depths not less than 36 inches below the finish grade surface.
- C. Setting Posts in Earth: Center and align posts in holes, space as required by manufacturer. Brace terminal post against structure as required.
 1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 - a. Unless otherwise indicated, set top of concrete footings 4 inches below finish grade.
- D. Setting Posts in Stone or Existing Concrete:
 1. Core drill 3-1/2 inch diameter holes 9 inches deep.
 2. Clean holes of loose material, insert posts, and fill space around post with exterior erosion-resistant anchoring cement, mixed and placed to comply with manufacturer's written instructions.
 3. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8 inch buildup, sloped away from post.
- E. Fence Assembly: Install fully assembled fence sections as indicated on Drawings. Set bottom rail of fence 3 inches above finish grade unless indicated otherwise.

3.2 CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

PART 4 - TABLES

Table 1 – Minimum Sizes for Montage II Posts			
Fence Posts	Panel Height		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements

Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type										
Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.										

END OF SECTION 32 31 19

SECTION 33 41 00 - STORM SEWERS AND APPURTENANCES

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers storm sewers, culverts, manholes, headwalls, inlets, junction boxes and miscellaneous items indicated in connection with the storm sewer system, complete. Excavation, trenching and backfilling are covered under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES.

1.2 SUBMITTALS

- A. Submit product data and shop drawings for ALL items to be installed.
- B. Refer to Section 01 33 00 for submittal procedures.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS FOR STRUCTURES

- A. Precast Concrete Structures
 - 1. **Unless otherwise specified, only precast concrete structures shall be installed.** Precast structures shall be traffic duty. Concrete for precast structures shall have a design strength of 4500 psi at 28 days. Precast structures shall be monolithic in design. Reinforcing steel shall be Grade 60 and shall meet ASTM A615.
- B. Mortar
 - 1. Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of Portland Cement and two parts of sand. The Portland Cement shall conform to the requirements of Federal Specification SS-C-192, Type I or II. The sand shall conform to the requirements of AASHTO Specification M-45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to ten percent (10%) of the volume of cement used. Hydrated lime shall conform to the requirements of Federal Specification SS-L-351, or ASTM Specification C-141. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but shall in no case exceed six gallons of water per sack of cement. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within thirty (30) minutes from the time the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar bead on the outside shall be protected for such period as is necessary to obtain satisfactory curing.
- C. Cast Iron
 - 1. Cast iron shall conform to ASTM Standard Specification A 48, latest edition, for Class 20 gray cast iron. Cast iron shapes shall conform to the dimensions shown and shall be clean and perfect, free from sand or blow holes, or other defects. Castings shall be factory coated

with asphaltum varnish. Twenty-three and one-half inch (23-1/2") manhole covers will be used for sewers forty-eight inches (48") diameter or less. Thirty-two-inch (32") manhole covers will be used for sewers in excess of forty-eight inches (48") in diameter.

D. Brick

1. **Brick structures shall only be used when specifically indicated on the drawings.** All structures shall be constructed, complete with covers in accordance with the details shown on the Drawings. Structures shall be constructed of solid precast segmental concrete masonry units or circular sections specially cast for use in manhole construction.

a. When Structures are to be constructed of brick, materials shall conform to the following:

Concrete:	As specified in the concrete specification.
Brick:	ASTM 662, Grade MW.
Segmental Concrete:	ASTM C139, except as modified herein. 1) Curing: Steam cured for at least 8 hours 2) Minimum Thickness: Upper 12 feet of manhole - 8 inches; Portion below 12 feet - 12 inches
Circular Precast Sections:	ASTM C478
Mortar:	1) Portland Cement - ASTM C150, Type II 2) Hydrated Lime - ASTM C207, Type S 3) Sand - Concrete Sand (fine aggregate which has been sieved through an 8-mesh screen 4) Volumetric Proportions - 1-part Portland Cement, 1/2-part hydrated lime, 3 parts sand 5) Mixing - Cement, lime, and sand shall be thoroughly mixed dry and only enough water added to form a mortar of the proper consistency.
Castings:	1) Iron - ASTM A 48 2) Coating - Hot asphaltum varnish applied the foundry.

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2.2 PIPE FOR CULVERTS AND STORM DRAINS

A. Pipe for storm drains and culverts shall be reinforced concrete pipe (RCP), ASTM C 76, Class III, unless otherwise indicated. Where HDPE (High-Density Polyethylene) is specified, the joints shall meet ASTM F477 and ASTM D3212 (watertight joints). All pipes shall have a smooth interior.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. All concrete segmental units shall be saturated with water before laying and shall be damp but free from surface water when laid.
- B. All mortar shall be used within 30 minutes after mixing. Mortar which has begun to be taken on

initial set, shall be discarded and shall not be mixed with additional cement or new mortar. All segmented concrete manholes shall be plastered on all outside surfaces and three feet (3') above the invert on all inside surfaces with mortar not less than one-half inch (1/2") thick. Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole with no increase in the velocity in the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to smooth clean surface. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of two inches (2") per foot. Circular precast sections shall be provided with a mastic gasket to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.

- C. Piping shall be constructed of the materials specified in this section, and in the manner indicated on the Drawings. Pipe shall be laid true to the grades shown on the Drawings. Any line in which opening or faulting of the joints occurs during backfill or before final inspection and acceptance, such that infiltration of material or a change in flow characteristics results, must be repaired or replaced to the satisfaction of the Engineer. Under no circumstances shall pipe be laid on unsuitable soft material, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and dewatering of trenches during construction shall be borne by the Contractor. Any section of the pipe already laid that is found to be defective or damaged shall be taken up and re-laid or replaced as directed by the Engineer immediately, without additional cost to the Owner.

3.2 INSTALLATION OF CONCRETE PIPE AND PRECAST CONCRETE BOX CULVERT

A. Laying Pipe

- 1. The laying of pipes on the prepared foundation shall be started at the outlet and with the spigot or tongue ends pointing in the direction of flow and shall proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. The Contractor shall furnish and place in position all the necessary batter boards for controlling the work. The batter boards shall be of sufficient size timber and shall be substantially supported. The boards and all location stakes must be properly maintained in place. The Contractor shall also furnish, at his own expense, good sound twilled lines for use in giving lines and grades and necessary plummets and graduated poles of an approved form.
- 2. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trenches without disturbing the prepared foundation and the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipes are placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipes shall be fitted and matched so that when laid in the bed they shall form a smooth, uniform conduit. Shape trench bottom and perform excavation as specified under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES. Shore and sheet as specified in SECTION 02150 - TRENCH SAFETY per Plans, and referenced documents.

B. Joints in Concrete Pipe

- 1. Unless otherwise specified, joints in reinforced and unreinforced concrete pipe, shall either be neoprene or rubber gasket joints as hereinafter described. Cold compound joints shall only be allowed when specifically noted in the specifications or contract drawings.

C. Neoprene or Rubber Gasket Joints

- 1. Joints made with neoprene, rubber, or other similar material that has been approved by the Engineer will be acceptable for use with reinforced or non-reinforced concrete pipe, either tongue and groove or bell and spigot. The ends of the pipe must be accurately made and designed for use with the gaskets. The type of joint and the gasket must have the approval of the Engineer and may be submitted to the Engineer for approval prior to

submitting bids for work on which its use is intended. The joint material and workmanship shall be such as to provide a watertight joint. Joints shall, unless otherwise specified, be pointed on the outside with cement mortar.

D. Bell and Spigot Pipe – Cold Compound Joints

1. The inside of the pipe bells and the outside of the spigot ends shall, while dry, be completely coated with joint primer. This coating shall be applied sufficiently in advance so that the primer will be thoroughly dry when the pipe is laid. Pipe twenty-four inches (24") and larger shall be primed at the point of manufacture. Apply a fillet of compound on the bottom half of the inside of the bell, press enough dry twisted jute into the compound to pass around the pipe and lap at the top and shove home the spigot of the pipe. Bring the jute around the pipe, firmly caulk into place. The jute should be sufficient to fill one-fourth (1/4) the depth of the bell. Fill the remaining three-fourths (3/4) of the depth of the bell with compound, taking care to leave no voids and provide sufficient compound to form a fillet sloping forty-five degrees from the outer end of the bell to the barrel of the next pipe.
2. Compound used for these joints shall be a well-known brand of material of proven worth, uniform in consistency and approved by the Engineer as being equal to RAM-NECK. Primer shall be of the type recommended by the manufacturer of the compound used.

E. Tongue and Groove Pipe – Cold Compound Joints

1. Unless otherwise specified, this type of joint shall be used for tongue and groove pipe joints not made with approved neoprene or rubber gaskets. The compound and primer shall be the same as described herein for use with bell and spigot pipe.
2. Both ends of the pipe shall, while clean and dry, be coated with primer on all surfaces that will be in contact with the compound. The primer shall be allowed to dry before the pipe is laid. Twenty-four inches (24") and larger pipe shall be primed at the factory.
3. After pipe has been set to proper line and grade in the trench a one-half (1/2") thick layer of the compound shall be troweled or otherwise placed on the groove end of the pipe covering about two-thirds (2/3) of the joint face around the entire circumference. Next the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. Care shall be taken to avoid leaving ridges of the compound projecting into the pipe in a manner that would obstruct the flow. The Contractor will make the necessary adjustment in the quality and consistency of the compound as the work progresses.
4. An outside band of the joint compound shall be installed completely around the circumference of the pipe at the joint. This will necessitate digging "bell holes" at each joint. The band shall have a thickness at the center of at least three-quarter inch (3/4) tapering uniformly to nothing approximately three inches (3") each side of the center. Where Class A bedding is used, the band may be omitted on portions of the joint that will be embedded in the cement-stabilized sand bedding.

F. Corrugated Steel Pipe

1. Fully bituminous coated corrugated steel pipe shall conform to FS WWP 405, Class I or II, Shape 1, 2, 3, with Coating A. Gauge of pipe shall be as indicated on the Drawings.
2. The space between pipe and connecting bands shall be kept free of dirt and grit so that corrugations fit snugly. Connecting band shall be tapped with soft head mallet of wood, rubber or plastic while being tightened to take up slack and insure tight joint. Fill annular space between abutting sections of fully paved pipe and pipe arch with bituminous material after jointing.
3. Unless otherwise specified, field joints shall be made with outside bands, each consisting of one or two pieces. Type, size, and gauge of band and size of angles and bolts shall be as indicated on the Drawings or as applicable for gauge and type of pipe used.

3.3 INSTALLATION OF HDPE PIPE

- A. HDPE Drainpipe shall be high-density corrugated polyethylene heavy-duty pipe and shall be manufactured in conformance with the latest AASHTO specifications of M294 Type S and AASHTO

M252. (ADS N12 or equivalent are acceptable materials)

- B. Joints and Fittings: Pipe and fittings shall conform to AASHTO M294 and AASHTO M252. Couplers shall cover not less than one full corrugation on each annular section of pipe.
- C. Bedding Material: Bedding material shall be cement-stabilized sand unless otherwise noted in the plans. **Refer to Specification 31 23 23.16 – Cement Stabilized Sand Bedding and Backfill.**

3.4 MANHOLES

- A. Installation
 - 1. Manhole installation shall be in strict compliance with the manufacturer's recommended installation procedures.
 - 2. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.
- B. Stubs
 - 1. Stubs shall be provided in manholes at the locations shown on the Plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.
- C. Backfilling
 - 1. Backfilling around manholes shall not begin until concrete base has cured for twenty-four (24) hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in layers not to exceed twelve inches (12") to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
 - 2. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.
- D. Finishing Manhole to Grade
 - 1. Construct chimneys using precast concrete rings to bring manholes to finish grade.
 - 2. Seal both the top and the bottom faces of concrete rings with "RAM-NEK" rope type mastic sealant.
- E. Manhole Frames and Covers
 - 1. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Manhole covers and Inlet Grates shall include all graphics, logos, and verbiage required by all regulatory agencies having jurisdiction over the project. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frame.

END OF SECTION 33 41 00

SECTION 33 44 19 - STORM WATER MANAGEMENT

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

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 STORM WATER MANAGEMENT

- A. "Storm Water Management" shall consist of all requirements to comply with current Texas Commission on Environmental Quality (TCEQ) Texas Pollutant Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements.

1.2 SCOPE

- A. The scope of this item includes satisfying the TPDES Permit Regulation including, but not limited to, any permits that shall be obtained and any construction practices, equipment, materials, labor, and structures necessary to conform with these regulations.

1.3 STANDARDS

- A. This section will be governed by the regulations of the city and or county have jurisdiction over the project.
- B. All provisions, technical specifications, guidelines, intent and construction practices detailed within this handbook will be considered a part of the technical specification and will have full force and effect regarding this project.

1.4 PERMITS

- A. The Contractor is responsible for the planning and implementation procedures for storm water pollution prevention plans (SWPPP) for this construction site. The SWPPP shall be fully developed and implemented before submitting a Notice of Intent (NOI) that this project will be covered by the final TPDES general permit requirements.
- B. The Contractor shall file the NOI with the TCEQ at least seven (7) days prior to the commencement of construction activities.
- C. The Contractor shall also prepare and submit inspection reports pertaining to the Storm Water Management for the City and file the Notice of Termination after the site has been stabilized.

1.5 PAYMENT

- A. Storm Water Management will be incidental to all other Bid Items in the bid proposal.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CONSTRUCTION

- A. The Contractor is responsible for all construction activities, structures, etc., associated with implementing the TPDES Permit and the SWPPP. This includes, but is not limited to, filter fabric fences, straw bale fences, temporary hydro-mulch seeding, sodding, inlet protection barriers, etc. that pertain to the intent of this section.

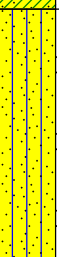
END OF SECTION 33 44 19

Boring Log No. B-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1103° Longitude: -95.6259° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
2		SANDY LEAN CLAY (CL) , dark gray, soft to very stiff, with ferrous nodules - tan and reddish brown, with ferrous stains 2 to 18 feet				2.5 (HP)				11.7		22-11-11	
						1.5 (HP)	UC	0.62	8.1	13.7	120		52.1
			5			0.5 (HP)				14.5		28-12-16	
						0.75 (HP)							
						0.5 (HP)							
			10			1.5 (HP)	UC	0.97	7.5	15.8	125		
						3.5 (HP)							
3		CLAYEY SAND (SC) , light gray and reddish brown, medium dense to dense	18.0	▼	×	12-22-27 N=49				15.1			33.3
				▼									
				▼									
						4.5 (HP)							
4		FAT CLAY (CH) , reddish brown and light gray, very stiff	28.0										
			30.0		×	8-12-14 N=26							
		Boring Terminated at 30 Feet	30										

Notes	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).	Water Level Observations ▼ While drilling ▼ After 5 minutes ▼ After 15 minutes	Drill Rig ATV Hammer Type Rope and Cathead Driller DAS
	See Supporting Information for explanation of symbols and abbreviations.		
	Advancement Method Dry augered to 23 feet; wet rotary thereafter.	Abandonment Method Boring backfilled with auger cuttings upon completion.	Logged by H. Zamudio
			Boring Started 03-24-2026 Boring Completed 03-24-2026

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1102° Longitude: -95.6255° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
3		SILTY SAND (SM) , dark gray, medium dense, with clay pockets	2.0			3.0 (HP)							
2		SANDY LEAN CLAY (CL) , tan and reddish brown, soft to hard, with ferrous stains and nodules - light gray 4 to 18 feet				1.5 (HP)			15.2		23-12-11		
			5			0.5 (HP)	UC	0.45	14.3	17.7	114		
						0.5 (HP)				17.2		29-13-16	
			10			1.0 (HP)							
						1.0 (HP)							
			15			4.5 (HP)	UC	4.17	13.6	18.0	110		
3		SILTY SAND (SM) , light gray and tan, very dense, with clay pockets	18.0										
			20			18-30-38 N=68							
			25			15-28-33 N=61			14.8				28.6
4		FAT CLAY (CH) , reddish brown, very stiff, with slickensides	30.0			4.5 (HP)							
		Boring Terminated at 30 Feet	30										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations

- ▽ While drilling
- ▽ After 5 minutes
- ▽ After 15 minutes

Drill Rig

ATV

Hammer Type

Rope and Cathead

Driller

DAS

Notes

Advancement Method

Dry augered to 25 feet; wet rotary thereafter.

Abandonment Method

Boring backfilled with auger cuttings upon completion.

Logged by

H. Zamudio

Boring Started

03-20-2026

Boring Completed

03-20-2026

Boring Log No. B-3

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1099° Longitude: -95.6557° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
2		SANDY SILTY CLAY (CL-ML) , dark gray, medium stiff	2.0			4.5 (HP)	UC	0.64	4	10.4	100	19-13-6	
3		SILTY SAND (SM) , dark gray, very loose	6.0			1-1-2 N=3							
			5			1-2-1 N=3				12.0		NP	
		SANDY LEAN CLAY (CL) , tan and light gray, soft to stiff, with ferrous stains and nodules	10			0.75 (HP)							
						0.5 (HP)							
			10			1.75 (HP)	UC	0.82	6.5	15.9	117		
2		- reddish brown 13 to 23 feet	15			2.0 (HP)							
			20			4.5 (HP)							
			23.0										
3		SILTY SAND (SM) , light gray and reddish brown, very dense	25			15-37-50 N=87				12.7			28.2
4		SANDY FAT CLAY (CH) , light gray and reddish brown, hard	30.0			9-16-25 N=41							
		Boring Terminated at 30 Feet	30										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations

- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig

ATV

Hammer Type

Rope and Cathead

Driller

DAS

Notes

Advancement Method

Dry augered to 22 feet; wet rotary thereafter.

Abandonment Method

Boring backfilled with auger cuttings upon completion.

Logged by

H. Zamudio

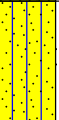
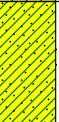
Boring Started

03-20-2026

Boring Completed

03-20-2026

Boring Log No. B-4

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1094° Longitude: -95.6260° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI		
2		SANDY LEAN CLAY (CL) , dark gray, very soft to stiff, with ferrous stains and nodules - light gray and reddish brown 4 to 18 feet				2.0 (HP)								
						1.5 (HP)			14.0		28-12-16			
			5			1.25 (HP)	UC	0.92	7.2	14.7	120			
						1.0 (HP)				16.5		31-13-18		
			10			1.25 (HP)								
						0.25 (HP)								
		18.0				2.0 (HP)	UC	0.63	5.9	17.3	111			
3		SILTY SAND (SM) , light gray and reddish brown, very dense, with clay pockets	20			16-30-35 N=65								
		23.0												
2		SANDY LEAN CLAY (CL) , light gray and reddish brown, very stiff	25			4.5 (HP)								
		28.0												
3		SILTY SAND (SM) , light gray and reddish brown, very dense, with clay pockets	30			20-50/5"								
		Boring Terminated at 30 Feet												

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations

- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig

ATV

Hammer Type

Rope and Cathead

Driller

DAS

Notes

Advancement Method

Dry augered to 20 feet; wet rotary thereafter.

Abandonment Method

Boring backfilled with auger cuttings upon completion.

Logged by

H. Zamudio

Boring Started

03-23-2026

Boring Completed

03-23-2026

Boring Log No. B-5

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1094° Longitude: -95.6256° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
3		SILTY SAND (SM) , dark gray, loose	2.0			1.0 (HP)				6.9		NP	
2		SANDY LEAN CLAY (CL) , dark gray, soft to very stiff				1.5 (HP)	UC	0.43	3.8	14.6	113		
		- light gray and reddish brown, with ferrous stains 4 to 23 feet	5			1.5 (HP)				14.9		22-11-11	
					0.5 (HP)								
		- with ferrous nodules 8 to 18 feet	10	▼		0.75 (HP)	UC	0.37	7	16.9	117		
				▼		1.75 (HP)							
				15	▼		3.0 (HP)						
			20			4.5 (HP)							
3		CLAYEY SAND (SC) , light gray and reddish brown, medium dense to very dense	25	✕		15-32-38 N=70							
			30			4.5 (HP)				13.4		28-14-14	28.2
4		FAT CLAY (CH) , reddish brown, stiff	35			2.0 (HP)	UU	1.77	15	20.4	108		
3		SILTY SAND (SM) , reddish brown, dense to very dense	40	✕		10-18-22 N=40							
			45	✕		7-14-28 N=42							
			50	✕		12-22-35 N=57							
		Boring Terminated at 50 Feet	50										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations

- ▼ While drilling
- ▼ After 5 minutes
- ▼ After 15 minutes

Drill Rig

ATV

Hammer Type

Rope and Cathead

Driller

DAS

Notes

Advancement Method

Dry augered to 15 feet; wet rotary thereafter.

Abandonment Method

Boring backfilled with auger cuttings upon completion.

Logged by

H. Zamudio

Boring Started

03-23-2026

Boring Completed

03-23-2026

Boring Log No. B-6

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1113° Longitude: -95.6229° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
1		FILL - POORLY GRADED SAND WITH SILT (SP-SM) , dark gray, with scattered gravel	2.0		X	17-10-15 N=25							
2		SANDY SILTY CLAY (CL) , dark gray, very stiff	4.0			2.25 (HP)				12.3		21-14-7	
		SANDY LEAN CLAY (CL) , light gray and reddish brown, stiff to very stiff, with ferrous stains				2.5 (HP)	UC	1.79	5.3	15.1	121		
						2.5 (HP)				14.9		46-17-29	
						3.75 (HP)							
						4.5 (HP)	UC	2.63	4.6	14.6	123		
						4.5 (HP)							
			20.0			4.5 (HP)							
Boring Terminated at 20 Feet			20										

Notes	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).	Water Level Observations No free water observed	Drill Rig ATV
	See Supporting Information for explanation of symbols and abbreviations.		
		Advancement Method Dry augered to 20 feet.	Driller DAS
		Abandonment Method Boring backfilled with auger cuttings upon completion.	Logged by H. Zamudio
			Boring Started 03-24-2026
			Boring Completed 03-24-2026

Boring Log No. B-7

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1112° Longitude: -95.6225° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
1		FILL - POORLY GRADED SAND WITH SILT (SP-SM) , dark gray, with scattered gravel	2.0		X	4-6-18 N=24				5.8		NP	
2		SANDY LEAN CLAY (CL) , light gray and reddish brown, medium stiff to very stiff, with ferrous stains - with ferrous nodules 2 to 8 feet	5			2.0 (HP)							
			5			1.0 (HP)	UC	0.60	5	17.5	108	41-16-25	
			10			1.0 (HP)							
			10			2.0 (HP)	UC	1.88	5.3	16.5	112		
			15			2.0 (HP)							
			15			4.5 (HP)							
			20			3.0 (HP)							
		Boring Terminated at 20 Feet	20										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations
No free water observed

Drill Rig
ATV
Hammer Type
Rope and Cathead
Driller
DAS

Notes

Advancement Method
Dry augered to 20 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio
Boring Started
03-24-2026
Boring Completed
03-24-2026

Boring Log No. B-8

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1112° Longitude: -95.6235° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
1		FILL - POORLY GRADED SAND WITH SILT (SP-SM) , dark gray, with scattered gravel	2.0		X	4-17-15 N=32							
2		SANDY LEAN CLAY (CL) , dark gray, stiff to very stiff - with ferrous stains and nodules 2 to 13 feet - light gray and reddish brown below 2 feet				1.25 (HP)				13.9		29-14-15	
			5			1.5 (HP)	UC	1.53	3.7	14.4	115		
						3.0 (HP)				15.4		46-16-30	
			10			4.5 (HP)							
						4.5 (HP)	UC	3.72	6.2	17.7	109		
			15			4.5 (HP)							
		20.0	20			4.5 (HP)							
		Boring Terminated at 20 Feet											

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations
No free water observed

Drill Rig
ATV
Hammer Type
Rope and Cathead
Driller
DAS

Notes

Advancement Method
Dry augered to 20 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio
Boring Started
03-24-2026
Boring Completed
03-24-2026

Boring Log No. B-9

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1109° Longitude: -95.6212° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	
1		FILL - SANDY LEAN CLAY (CL), dark gray, with scattered gravel 2.0	5			1.5 (HP)				13.1		26-14-12	
2		SANDY LEAN CLAY (CL), dark gray and reddish brown, stiff, with ferrous nodules 5.0 - tan below 4 feet				1.75 (HP)							
		Boring Terminated at 5 Feet				1.75 (HP)							

See **Supporting Information** for explanation of symbols and abbreviations.

See **Supporting Information** for explanation of symbols and abbreviations.

No free water observed

ATV

DAS

H. Zamudio

03-24-2026

03-24-2026

Notes

Advancement Method

Advancement Method
Dry augered to 5 feet.

Abandonment Method

completion.

Supporting Information

Contents:

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

Sampling	Water Level	Field Tests
 Shelby Tube  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification
Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes
Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms				
Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		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		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	5 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	9 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	16 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results
Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 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:	$\frac{LL\text{ oven dried}}{LL\text{ not dried}} < 0.75$	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:	$\frac{LL\text{ oven dried}}{LL\text{ not dried}} < 0.75$	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 $\geq 15\%$ 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 $\geq 15\%$ 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 $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ 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.

