Texas Parks and Wildlife
Infrastructure Division

4200 Smith School Road
Austin, Texas 78744-3292

Technical Specifications
for Construction of

Galveston Island State Park
Beachside Redevelopment
Project No. CC.127436.SP

100% Construction Documents
Issued for Bidding
April 3, 2020

swa

SWA Group
The Jones on Main
712 Main Street, 6th Floor
Houston, Texas 77002
713-868-1676
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The specification sections listed below were prepared by or under the direct supervision of the Landscape Architect:

SWA
712 Main St. 6th Floor
Houston, Texas 77002

**Division 01** General Requirements
01 74 19 Construction Waste Management and Disposal

**Division 02** Existing Conditions
02 41 19 Selective Demolition

**Division 06** Wood, Plastics, and Composites
06 15 33 Wood Decking

**Division 09** Finishes
09 96 00 High Performance Coatings

**Division 10** Specialties
10 75 16 Ground-Set Flagpoles

**Division 32** Exterior Improvements
32 13 14 Pedestrian Concrete Paving
32 13 14 Gate Operators
32 92 00 Turf and Grasses
The specification sections listed below were prepared by or under the direct supervision of the Engineer:

BGE, Inc.
Firm #F-1046
700 N. Pearl Street, Suite 2100
Dallas, Texas 75201

Division 09  Finishes
09 97 13  Steel Coatings

Division 31  Earthwork
31 23 19  Dewatering
31 23 23.13  Backfill
31 23 33  Trenching and Backfilling
31 41 33  Trench Safety System
31 73 00  Tunnel Grouting

Division 32  Exterior Improvements
32 31 13  Chain Link Fences and Gates

Division 33  Utilities
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33 05 04  Selective Demolition for Utilities
33 05 05.31  Hydrostatic Testing
33 05 07.36  Microtunneling
33 05 31.13  Polyvinyl Chloride Pressure Pipe
33 05 31.19  Fusible Polyvinyl Chloride Pipe
33 05 61  Concrete Manholes
33 14 16  Site Water Utility Distribution Piping
33 31 11.12  Ductile Iron Pipe and Fittings
33 31 16  Site Sanitary Sewerage Gravity Piping
33 31 23  Sanitary Sewerage Force Main Piping
33 32 16  Packaged Wastewater Grinder Pump Assemblies

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The specification sections listed below were prepared by or under the direct supervision of the Engineer:

**CSF Consulting, LP**  
11301 Fallbrook Suite 320  
Houston, Texas 77065

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GSMA  
5305 Jackson St.  
Houston, Texas 77004

**Division 03**  Concrete  
03 10 00  Concrete Formwork

**Division 05**  Metals  
05 51 50  Ladders

**Division 06**  Wood, Plastics, and Composites  
06 10 00  Rough Carpentry  
06 17 53  Shop-Fabricated Wood Trusses  
06 20 00  Interior Finish Carpentry  
06 40 00  Architectural Casework and Countertops  
06 41 93  Interior Hardware Schedule

**Division 07**  Thermal and Moisture Protection  
07 21 00  Building Insulation  
07 31 13  Asphalt Shingles  
07 46 00  Fiber Cement Siding  
07 61 00  Standing Seam Roofing  
07 62 00  Sheet Metal Flashing Gutters and Trim  
07 65 00  Flexible Flashing  
07 92 00  Joint Sealants

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08 14 00  Wood Doors  
08 45 23  Fiberglass Skylights  
08 52 00  Vinyl Windows  
08 71 00  Door Hardware  
08 80 00  Glazing and Mirrors

**Division 09**  Finishes  
09 21 00  Gypsum Board Assemblies  
09 30 00  Tiling  
09 90 00  Painting and Staining

**Division 10**  Specialties  
10 14 00  Signage  
10 28 00  Toilet Accessories  
10 44 00  Fire Protection Specialties

**Division 27**  Communications  
27 20 00  Data Communications  
27 30 00  Voice Communications  
27 40 00  Audio-Video Systems

**Division 28**  Electronic Safety and Security  
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31 31 16  Termite Control

### Division 32  Exterior Improvements
32 01 90  Tree and Plant Protection
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The specification sections listed below were prepared by or under the direct supervision of the Engineer:

Hunt & Hunt Engineering Corp.
P.O. Box 771294
Houston, Texas 77215
TBPE Firm No. F-3446

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22 00 00  Plumbing General
22 05 01  Plumbing Specialties
22 07 19  Plumbing Piping Insulation
22 13 16  Plumbing Piping
22 33 33  Plumbing Equipment
22 40 00  Plumbing Fixtures and Trim

Division 23  Heating, Ventilating, and Air Conditioning (HVAC)
23 00 00  Mechanical Basic Materials and Methods
23 05 29  Supports, Anchors and Seals
23 05 48  Vibration Isolation
23 05 53  Mechanical Identification
23 05 93  Testing, Adjusting and Balancing
23 07 13  Ductwork Insulation
23 07 16  Insulation of Mechanical Systems
23 07 19  Piping Insulation
23 09 93  Sequence of Operations for HVAC Controls
23 11 26  Facility Liquefied-Petroleum Gas Piping
23 20 00  Valves, Cocks and Faucets
23 31 00  Ductwork
23 33 00  Duct Accessories
23 34 16  Fans
23 37 00  Air Distribution Devices
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23 73 13  Packaged A/C Units

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26 05 29  Supporting Devices
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26 24 16  Panelboards
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26 27 23  Device, Pull and Junction Boxes
26 27 26  Wiring Devices
26 28 11  Enclosed Circuit Breakers
26 28 16  Disconnect Switches
26 32 13  Engine Generators
26 51 00  Lighting Fixtures
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SECTION 015710 – NPDES REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Requirements for documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with terms and conditions of National Pollutant Discharge Elimination System (NPDES) Permit as stated in the Federal Register Vol. 57 No 175, issued by the Environmental Protection Agency on September 9, 1992.

2. Contractor's responsibility for implement, maintain and inspect 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 similar other practices shown on the Drawings or specified elsewhere in this or other Specifications.

3. Meet with the Owner's Representative and Architect/Engineer to review implementation of the Storm Water Pollution Prevention Plan (SWPPP) prior to proceeding with earthwork operations.

B. Related Work:

1. Section 01 57 20 - Erosion and Sedimentation Control.
2. Section 01 57 30 - Filter Fabric Fence.
3. Section 01 57 40 - Reinforced Filter Fabric Barrier.
4. Section 01 57 50 - Stabilized Construction Exit.
5. Section 01 57 60 - Waste Material Disposal.
6. Section 01 57 80 - Ground and Surface Water Control.
7. Refer to civil drawings.
8. Refer to Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions TPWD

C. Notice of Intent: Contractor shall fill out, sign, and date Contractor's Notice of Intent (NOI) attached as Figure 1 at the end of this Section. Return signed copy of the Contractor's NOI to Owner. Owner will complete Owner's Notice of Intent attached as Figure 2 and will submit both notices to the EPA. Submission of the NOI's is required by both Owner and Contractor before start of construction operations.

D. Retention of Records: Keep a copy of the Storm Water Pollution Prevention Plan at the construction site or at Contractor's office from date that it became effective to the date of project completion. At Project close-out, Contractor shall submit to Owner all NPDES forms and a copy of the SWPPP. Storm water pollution prevention records and date will be retained by Owner for a period of 3 years from Date of Final Completion.

E. Required Notices: Post the following notices from the date that this SWPPP goes into effect until the date of final site stabilization:

1. Copies of the Notices of Intent submitted by the Owner and Contractor and a brief project description, as given in Paragraph 1.1 of the SWPPP, shall be posted at the construction site or at Contractor's office in a prominent place for public viewing.
2. Notice to drivers of equipment and vehicles, instructing them to stop, check and clean tires of debris and mud before driving onto traffic lanes. Post such notices at every construction exit area.

3. In an easily visible location on site, post a notice of waste disposal procedures.

4. Notice of hazardous material handling and emergency procedures shall be posted with the NOI on site. Keep copies of Material Safety Data Sheets at a location on site that is known to all personnel.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED
Figure 1 - Contractor’s Notice of Intent (NOI)

Instructions - EPA Form 3510-4
Notice Of Intent (NOI) For Storm Water Discharges Associated With Industrial Activity
To Be Covered Under a NPDES General Permit

Who Must File A Notice Of Intent (NOI) Form

Federal law at 40 CFR Part 122 prohibits point source discharges of storm water associated with industrial activity to a water body(s) of the U.S. without a National Pollution Discharge Elimination System (NPDES) permit. The operator of an industrial activity that has such a storm water discharge must submit a NOI to obtain coverage under a NPDES Storm Water General Permit. If you have questions about whether you need a permit under the NPDES Storm Water Program, or if you need information as to whether a particular program is administered by EPA or a state agency, telephone or write to the Notice of Intent Processing Center at (703) 931-3320.

Where To File NOI Form

NOIs must be sent to the following address:
Storm Water Notice of Intent (4203)
401 M Street, S.W.
Washington, DC 20460

Completing The Form

You must type or print, using upper-case letters, in the appropriate areas only. Please place each character between the marks. Abbreviations if necessary to stay within the number of characters allowed for each item. Use one space for breaks between words but not for punctuation marks unless they are needed to clarify your responses. If you have any questions on the form, call the Notice of Intent Processing Center at (703) 931-3320.

Section I Permit Selection

You must indicate the NPDES storm water general permit under which you are applying for coverage. Check one box only. The Baseline Industrial and Baseline Construction permits were issued in September 1993. The Multi-Sector Permit became effective October 1, 1995.

Section II Facility Operator Information

Provide the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in this application. The name of the operator may or may not be the same as the name of the facility. The responsible party is the legal entity that controls the facility’s operation, rather than the plant or site manager. Do not use a colloquial name. Enter the complete address and telephone number of the operator.

Enter the appropriate letter to indicate the legal status of the operator of the facility:
F = Federal; S = State; M = Public (other than federal or state); P = Private

Section III Facility/Site Location Information

Enter the facility’s or site’s official or legal name and complete street address, including city, state, and zip code. Do not provide a P.O. Box number as the street address. Even if applying for a Baseline Permit and the facility or site lacks a street address, indicate the state and either the latitude and longitude of the facility to the nearest 15 seconds of the quarter, section, township, and range (to the nearest quarter section) of the approximate center of the site. All applicants must indicate whether the facility is located on Indian lands.

Section IV Site Activity Information

If the storm water discharges to a municipal separate storm sewer system (MS4), enter the name of the operator of the MS4 (e.g., municipality name, county name) and the receiving water of the discharge from the MS4. (A MS4 is defined as a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that is owned or operated by a state, city, town, borough, county, parish, district, association, or other public body which is designed for collecting or conveying storm water.

If the facility discharges storm water directly to receiving water(s), enter the name of the receiving water(s).

If you are filing as a co-permittee and a storm water general permit number has been issued, enter that number in the space provided.

Indicate the monitoring status of the facility. Refer to the permit for information on monitoring requirements. Indicate whether all the following:
1 = Subject to monitoring requirements and required to submit data
2 = Subject to monitoring requirements but not required to submit data
4 = Subject to monitoring requirements but submitting certification for monitoring exclusion.

List in descending order of significance, up to two 4-digit standard industrial classification (SIC) codes. Codes that best describe the principal products or services provided or the facility or sites identified in Section I of this application. If you are applying for coverage under the construction general permit, enter “C” which represents SIC codes 1500 - 1799.

For industrial activities defined in 40 CFR 122.26(b)(14)(iv) (c) that do not have SIC codes that accurately describe the principal products produced or services provided, use the following 2-character codes.

H2 = Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under subparts C or RCRP [40 CFR 122.26 (b)(14)(iv)]
LF = Landfills, land application sites, and open dumps that receive or have received any industrial waste, including those that are subject to regulation under subpart D of RCRP [40 CFR 122.26 (b)(14)(iv)]
SE = Steam electric power generating facilities, including coal handling sites [40 CFR 122.26 (b)(14)(iv)]
TW = Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage [40 CFR 122.26 (b)(14)(iv)]; or
CO = Construction activities [40 CFR 122.26 (b)(14)(iv)]

If there is another NPDES permit presently issued for the facility or site listed in Section III, enter the permit number. If an application for the facility has been submitted but no permit number has been assigned, enter the application number.

Facilities applying for coverage under the Multi-Sector storm water general permit must answer the set three questions in Section IV. Refer to Addendum H of the Multi-Sector general permit for a list of species that are either proposed or listed as threatened or endangered. "BMP" means Best Management Practices that are used to control storm water discharges.

Indicate whether any construction will be conducted to install or develop storm water runoff controls.

Section V Additional Information Required for Construction Activities Only

Construction activities must complete Section V in addition to Sections I through IV. Only construction activities needs to complete Section V.

Enter the project start date and the estimated completion date for the entire development plan.

Provide an estimate of the total number of acres of the site on which soil will be disturbed (rounded to the nearest acre).

Indicate whether the storm water pollution prevention plan for the site is in compliance with approved state and/or local sediment and erosion plans, permits, or storm water management plans.

Section VI Certification

Federal regulations provide for severe penalties for submitting false information on this application form. Federal regulations require the application to be signed as follows:
For a corporation: by a responsible corporate officer which means its president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions, or (b) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1993 dollars), if the authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.
For a partnership or sole proprietorship: by a general partner of the proprietor, or
For a municipality, state, Federal, or other public facility: by either a principal executive officer or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this application is estimated to average 0.5 hours per application, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce the burden to: Chief, Information Policy Branch, 2335, U.S. Environmental Protection Agency, P.O. Drawer, Washington, DC 20460; or Director, Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

Instructions for Figure 1 - Contractor’s Notice of Intent (NOI)

4.3.2020
100% Construction Documents

NPDES Requirements
015710 - 3
### Owner's Notice of Intent (NOI)

#### Figure 2 - Owner’s Notice of Intent (NOI)

**NPDES Form**

**EPA**

**Notice of Intent (NOI) for Storm Water Discharges Associated with Industrial Activity Under a NPDES General Permit**

Submittal of this Notice of Intent constitutes notice that the party identified in Section II of this form intends to be authorized by a NPDES permit issued for storm water discharges associated with industrial activity in the State identified in Section III of this form. Becoming a permittee obligates such discharger to comply with the terms and conditions of the permit. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM.

### I. Permit Selection

You must indicate the NPDES Storm Water permit under which you are applying for coverage.

- Baseline
- Industrial
- Baseline
- Construction
- Multi-Sector
- (Group Permit)

### II. Facility Operator Information

- **Name:**
- **Address:**
- **City:**
- **State:**
- **ZIP Code:**
- **Phone:**
- **Status of Owner/Operator:**

### III. Facility/Site Location Information

- **Name:**
- **Address:**
- **City:**
- **State:**
- **ZIP Code:**
- **Is the facility located on Indian Land?** (Yes or No)

### IV. Site Activity Information

- **MS4 Operator Name:**
- **Receiving Water Body:**
- **If you are filing as a co-permittee under storm water general permit number:**
- **SC or Designated Activity Code:**
- **Primary:**
- **2nd:**
- **Is the facility required to submit monitoring data?** (1, 2, 3, or 4)
- **If you have another existing NPDES Permit, enter Permit Number:**

### V. Additional Information Required for Construction Activities Only

- **Project Start Date:**
- **Completion Date:**
- **Estimated Area to be Disturbed (in Acres):**
- **Is the Storm Water Pollution Prevention Plan in compliance with State and/or Local sediment and erosion plans?** (Yes or No)

### VI. Certification

**BOX 1**

ALL APPLICANTS:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted to, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of the and imprisonment for knowing violations.

**BOX 2**

MULTI-SECTOR STORM WATER GENERAL PERMIT APPLICANTS ONLY:

I certify under penalty of law that I have read and understand the Part I.D. eligibility requirements for coverage under the Multi-Sector Storm Water general permit, including those requirements relating to the protection of species identified in Addendum H.

To the best of my knowledge, the discharges covered under this permit, and construction of BMPs to control storm water runoff, are not likely to and will not likely adversely affect any species identified in Addendum H of the Multi-Sector Storm Water general permit or are otherwise eligible for coverage due to previous authorization under the Endangered Species Act.

To the best of my knowledge, I further certify that such discharges, and construction of BMPs to control storm water runoff, do not have an effect on properties listed or eligible for listing on the National Register of Historic Places under the National Historic Preservation Act, or are otherwise eligible for coverage due to a previous agreement under the National Historic Preservation Act.

I understand that coverage under the Multi-Sector general permit is contingent upon maintaining eligibility as provided for in Part I.D.
Instructions for Figure 2 – Owner’s Notice of Intent (NOI)

END OF SECTION 015710
SECTION 015720 – EROSION & SEDIMENTATION CONTROL

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes description of erosion and sediment control and other control-related practices that shall be utilized during construction activities.

B. Related Work:
   1. Section 01 57 10 – NPDES Requirements
   2. Section 01 57 30 – Filter fabric Fence
   3. Section 01 57 40 – Reinforced Filter Fabric Barrier
   4. Section 01 57 60 – Waste Material Disposal
   5. Refer to civil drawings.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 INSTALLATION

A. Preparation and Installation:
   1. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Architect/Engineer to allow soil testing and surveying.
   2. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately by the Contractor.
   3. Contractor is responsible for collecting, storing, hauling, and disposing of soil, silt, and waste materials as specified in this or other specifications and in compliance with applicable federal, state, and local rules and regulations.
   4. Contractor shall conduct all construction operations under this contract in conformance with the erosion control practices described in the drawings and this specification.
   5. Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified in the drawings and in this or other specifications.

B. Topsoil Placement for Erosion and Sediment Control Systems:
   1. When topsoil is specified as a component of another specification, Contractor shall conduct erosion control practices described in this specification during topsoil placement operations.
   2. When placing topsoil, maintain erosion and sediment control systems, such as sales, grade stabilization structures, berms, dikes, waterways, and sediment basins.
3. Maintain grades that have been previously established on areas to receive topsoil.

4. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, loosen the subgrade by discing or by scarifying to a depth of at least 2 inches to permit bonding of topsoil to subsoil.

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

C. Dust Control:

1. Implement dust control methods to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving streams or storm water conveyance systems, to reduce on-site and off-site damage, to prevent health hazards, and to improve traffic safety.

2. Control blowing dust by using one or more of the following methods:
   a. Mulches bound with chemical binders.
   b. Temporary vegetative cover.
   c. Spray-on adhesives on mineral soils when not used by traffic.
   d. Tillage to roughen surface and bring clods to the surface.
   e. Irrigation by water sprinkling.
   f. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.

3. Implement dust control methods immediately whenever dust can be observed blowing on site.

D. Keeping Streets Clean:

1. Keep streets clean of construction debris and mud carried by construction vehicles and equipment. If necessary to keep streets clean, install 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 stabilized construction exit, as needed. Release wash water into a drainage swale or inlet protected by erosion and sediment control measures.

2. Instead of or in addition to stabilized construction exits, shovel or sweep pavement to the extent necessary to keep streets clean. Water hosing or sweeping of debris and mud off streets into adjacent areas is not allowed.

E. Equipment Maintenance and Repair:

1. Confining maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose. Locate such areas so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed directly into receiving streams or stormwater conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid as well as solid waste. Clean and inspect maintenance areas daily.

2. On a construction site where designated equipment maintenance areas not feasible, take precautions during each individual repair or maintenance operation...
to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

F. Waste Collection and Disposal:

1. Contractor shall formulate and implement a plan for collection and disposal of waste 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. Make special provisions for collection and disposal of liquid wastes and toxic or hazardous materials.

2. Keep receptacles and waste collection areas neat and orderly to extent possible. Waste shall not be allowed to overflow its container or accumulate from day-to-day. Locate trash collection points where they will least likely be affected by concentrated storm water runoff.

G. Washing Areas:

1. Vehicles such as concrete delivery trucks or dump trucks and other construction equipment shall not be washed at locations where runoff will flow directly into a watercourse or storm water conveyance system.

2. Designate special areas for washing vehicles.

3. Locate these areas where wash water will spread out and evaporate or infiltrate directly into ground, or where runoff can be collected in a temporary holding or seepage basin.

4. Beneath wash areas construct a gravel or rock base to minimize mud production.

H. Storage of Construction Materials and Chemicals:

1. Isolate sites where chemicals, cements, solvents, paints or other potential water pollutants are stored in areas where they will not cause runoff pollution.

2. Store toxic chemicals and materials such as pesticides, paints, and acids in accordance with manufacturer's guidelines.

3. Protect ground water resources from leaching by placing a plastic mat, packed clay, tar-paper, or other impervious materials on any areas where toxic liquids are to be opened and stored.

I. Demolition Areas:

1. Conduct demolition activities which create large amounts of dust with significant concentrations of heavy metals or other toxic pollutants with dust control techniques to limit transport of airborne pollutants. However, retain water or slurry used to control dust contaminated with heavy metals or toxic pollutants on Site and take measures to eliminate runoff directly into watercourses or storm water conveyance systems.

2. Use only methods of ultimate disposal of these materials and carry out disposal only in accordance with applicable local, state, and federal health and safety regulations.
J. Sanitary Facilities:

1. Provide construction sites with adequate portable toilets for workers in accordance with Section 01500 - Temporary Facilities and Controls, and applicable health regulations.

K. Pesticides:

1. Use and store pesticides during construction in accordance with manufacturer's guidelines and with local, state and federal regulations.

2. Avoid overuse of pesticides which could produce contaminated runoff.

3. Take great care to prevent accidental spillage.

4. Never wash pesticide containers in or near flowing streams or storm water conveyance systems.

END OF SECTION 015720
SECTION 015730 – FILTER FABRIC FENCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes installation of erosion and sediment control filter fabric fences used during construction and until final development of the site. The purpose of filter fabric fences is to contain pollutants from overland flow. Filter fabric fences are not for use in channeled flow areas.

B. Related Work:

1. Section 01 57 10 - NPDES Requirements.
2. Section 01 57 20 - Erosion and Sedimentation Source Controls.
3. Section 01 57 40 - Reinforced Filter Fabric Barrier.
4. Section 01 57 60 - Waste Material Disposal.
5. Refer to civil drawings

C. References:

1. ASTM D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted goods and Non-woven Fabrics
2. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D. Submittals:

1. Submit manufacturer's catalog sheet and other product data on geotextile fabric.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Filter Fabric:

1. Provide woven or nonwoven geotextile filter fabric made of polypropylene, polyethylene, ethylene, or polyamide material; Mirafi or equivalent accepted by Architect.

2. Geotextile fabric shall have 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.

3. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0° F to 120° F.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation, General:

1. Provide erosion and sediment control systems at locations shown on drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on drawings and specified in this Section.

2. No clearing or grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than site work specifically directed by the Architect to allow soil testing and surveying.

3. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by Engineer/Owner to remove and discard the existing system.

4. Regularly inspect and repair or replace damaged components of filter fabric fences as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until the project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed by the Engineer/Owner. Discard removed materials off Site.

5. Remove sediment deposits and dispose of them at designated spoil site for project. If a project spoil site is not designated on the drawings, dispose of sediment off site at a location not in or adjacent to a stream or flood plain. Off-site disposal is the responsibility of Contractor. Sediment placed at project site should be spread evenly throughout site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, dispose of in accordance with existing federal, state, and locate rules and regulations.

6. Equipment and vehicles shall be prohibited by Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.

7. Conduct all construction operations under this contract in conformance with the erosion control practices described in Section 015720 - Erosion and Sedimentation Source Controls.

B. Installation:

1. Provide filter fabric fence installed in such a manner that surface runoff will percolate through system in sheet flow fashion and allow sediment to be retained and accumulated.

2. Attach filter fabric to 1 x 2 wooden stakes spaced maximum 3 feet on center and embedded a minimum of 8 inches. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 6 feet. Install wooden stakes at a slight angle toward source of anticipated runoff.
3. Trench in the toe of filter fabric fence with a spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow as shown on the Storm Water Pollution Prevention Plan (SWPPP). Lay filter fabric along the edges of the trench. Backfill and compact trench.

4. Provide filter fabric fence minimum 18-inch high and a maximum 36-inch high above natural ground.

5. Provide the filter fabric in continuous rolls and cut to length of fence to minimize use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

6. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth on-third the height of the fence or 6-inches, whichever is less.

END OF SECTION 015730
SECTION 015740 – REINFORCED FILTER FABRIC BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes installation of reinforced filter fabric barriers for erosion and sediment control used during construction until final development of Site. Use reinforced filter fabric barriers to retain sedimentation in channelized flow areas.

B. Related Work:

1. Section 01 57 10 - NPDES Requirements.
2. Section 01 57 20 - Erosion and Sedimentation Source Controls.
3. Section 01 57 40 - Filter Fabric Barrier.
4. Section 01 57 60 – Waste Material Disposal.
5. Refer to civil drawings

C. References:

1. ASTM D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted goods and Nonwoven Fabrics
2. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D. Submittals:

1. Submit manufacturer’s catalog sheet and other product data on geotextile fabric.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Filter Fabric:

1. Provide woven or nonwoven geotextile filter fabric of polypropylene, polyethylene, ethylene, or polyamide material; Mirafi 140NS or equivalent accepted by Architect.

B. Physical Properties:

1. Provide filter fabric with minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and equivalent opening size between 50 and 14a.

C. Durability:

1. Provide filter fabric with ultraviolet inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0°F to 120°F.
D. Fencing:
   1. Provide galvanized welded steel wire fence with minimum thickness of 14 gages and a maximum mesh spacing of 6 inches.
   2. Provide galvanized 2-inch by 4-inch welded wire-fabric, 12 ½ gage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation and Installation:

   1. Provide erosion and sediment control systems at locations shown on the Storm Water Pollution Prevention Plan (SWPPP) and specified in this Section.

   2. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Architect/Engineer to allow soil testing and surveying.

   3. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Architect/Engineer to remove and discard the existing system.

   4. Regularly inspect and repair or replace damaged components of reinforced filter fabric barrier as specified in this Section. Unless otherwise directed, maintain the erosion and sediment control systems until project area stabilization is accepted by the Engineer/Owner. Remove erosion and sediment control systems promptly when directed by Engineer/Owner. Discard removed materials off site.

   5. Remove sediment deposits and dispose of them at designated spoil site for project. If a project spoil site is not designated on the Storm Water Pollution Prevention Plan (SWPPP), dispose of sediment off Site at a location not in or adjacent to a stream or flood plain. Off-Site disposal is the responsibility of Contractor. Sediment to be placed at the project site should be spread evenly throughout site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

   6. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.

   7. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 015720 - Erosion and Sedimentation Source Controls.

B. Filter Fabric Fence Construction and Monitoring:

   1. Provide filter fabric barriers in accordance with the Storm Water Pollution Prevention Plan (SWPPP) drawing detail for 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.

2. Attach woven wire support to 1-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Install wooden stakes at a slight angle toward the source of the anticipated runoff.

3. Trench in toe of filter fabric barrier with a spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow as shown on the Storm Water Pollution Prevention Plan (SWPPP) Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.

4. Securely fasten the filter fabric material to the woven wire with tie wires.

5. Reinforced filter fabric barrier shall have a height of 18 inches.

6. Provide filter fabric in continuous rolls and cut to the length of fence to minimize joints. When joints are necessary, splice fabric together only at support posts with a minimum 6-inch overlap and seal securely.

7. Inspect reinforced filter fabric barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately. Remove sediment deposits when silt reaches a depth one-third the height of the barrier or 6 inches, whichever is less.
SECTION 015750 – STABILIZED CONSTRUCTION EXIT

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes furnishing and installing erosion and sediment control for stabilized construction exits used during the construction and until final development of the site.

B. Related Work:
   1. Section 01571 – NPDES Requirements.
   2. Section 01572 – Erosion and Sedimentation Source Controls.
   6. Section 01578 – Ground and Surface Water Control.
   7. Refer to civil drawings.

C. Submittals:
   1. Manufacturer’s catalog sheets and other product data on geotextile fabric.
   2. Sieve analysis of aggregates conforming to requirements of this Specification

D. References:

PART 2 – PRODUCTS

2.1 MATERIAL

A. Geotextile Fabric
   1. Provide woven or non-woven geotextile fabric made of polypropylene, polyethylene, ethylene, or polyamide material.
   2. 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.
   3. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0°F to 120°F.
   4. Manufacturer: Mirafi, Inc., or equivalent.

B. Coarse Aggregates
   1. Provide material consisting of crushed stone, gravel, crushed blast furnace slag, or a combination of these materials that are clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.
2. Coarse aggregates shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size (Square Mesh)</th>
<th>Percent Retained (By Weight)</th>
</tr>
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<td>0 - 20</td>
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<tr>
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<td>60 - 80</td>
</tr>
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</tr>
</tbody>
</table>

PART 3 – EXECUTION

3.1 INSTALLATION

A. Preparation

1. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the drawings and specified in this Section.

2. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the engineer to allow soil testing and surveying.

3. Maintain existing erosion and sediment control systems located within the Project Site until acceptance of the Project or until directed by the Engineer to remove and discard the existing system.

4. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the Project is accepted by the Owner. Remove stabilized construction roads and exits promptly when directed by the Engineer. Discard removed materials off site.

5. Remove excess excavated material and sediment deposits and provide legal disposal of them off Project Site at location not in or adjacent to a stream or flood plain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the Project Site should be spread evenly within areas indicated to be regraded. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.

6. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control systems.

7. Conduct all construction operations under this Contract in conformance with the erosion control practices described in Section 01573 – Erosion and Sedimentation Source Controls.

B. Construction Methods:

1. Provide stabilized access roads, parking areas, wash-off areas, and other on-site vehicle transportation routes where approved by Engineer and Owner’s Representative.

2. Provide stabilized construction exits and truck washing areas, as approved by the Engineer, and of the sizes and locations approved by the Owner’s Representative.
3. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas that drain into a drainage system protected by erosion and sediment control measures.

4. The length of the stabilized area shall be not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Stabilized area may be widened or lengthened to accommodate truck washing area. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit.

5. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.

6. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.

7. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

END OF SECTION 01 57 50
SECTION 015760 – WASTE MATERIAL DISPOSAL

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes disposal of waste material and salvageable material.

B. Related Work:
   1. Section 015710 – NPDES Requirements.
   2. Section 015720 – Erosion and Sedimentation Source Controls.
   5. Section 015750 – Stabilized Construction Exit.
   6. Section 015780 – Ground and Surface Water Control.
   7. Refer to civil drawings.

C. Submittals:
   1. Submittals shall conform to requirements of Section 01330 – Submittal Procedures.
   2. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances.
   3. Submit a copy of written permission from the property owner, along with a description of the property, prior to disposal of excess material adjacent to the Project. Submit a written and signed release from the property owner upon completion of the disposal work.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

A. Salvageable Material:
   1. Excavated Material: When indicated on drawings, load, haul, and deposit excavated material at a location or locations shown on drawings outside the limits of the Project.
   2. Other Salvageable Materials: Conform to requirements of Section 02230 – Site Clearing.

B. Excess Material:
   1. Vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage, shall become the property of Contractor and shall be removed from the job site and legally disposed of.
   2. Excess soil may be deposited on private property adjacent to the Project when written permission is obtained from the property owner.
   3. Verify the flood plain status of any proposed disposal site. Do not dispose of excavated materials in an area designated as within the 100-year Flood Hazard Area unless a “Development Permit” has been obtained. Excess material placed in a “100-year Flood Hazard Area” within the site, without a “development Permit” shall be removed by the Contractor at no additional cost to the owner.
4. Waste materials shall be removed from the site on a daily basis, such that the site is maintained in a near and orderly Condition.

END OF SECTION 015760
SECTION 015770 – SANDBAGS FOR EROSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes furnishing and placement of sandbags for the purpose of temporary erosion control as outlined in the special specification item "Temporary Erosion, Sedimentation and Water Pollution Prevention and Control".

B. Related Work:
   1. Section 01 57 10 - NPDES Requirements
   2. Section 01 57 20 - Erosion and Sedimentation Source Controls.
   3. Section 01 57 40 - Reinforced Filter Fabric Barrier.
   4. Section 01 57 50 - Stabilized Construction Exit.
   5. Section 01 57 80 - Ground and Surface Water Control.
   Refer to civil drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The sandbags furnished on this contract shall consist of a suitable sandbag material and a coarse grade of sand with the following gradation:

PERCENT BY WEIGHT:

| PASSING NO. | 4 SIEVE | MINIMUM 97% |
| PASSING NO. | 100 SIEVE | MAXIMUM 20% |
| PASSING NO. | 200 SIEVE | MAXIMUM 5% |

(OR AS APPROVED BY THE ENGINEER)

B. The sandbag material shall be polypropylene, polyethylene or polyamide woven fabric with a minimum unit weight of four (4) ounces per square yard. The Mullen burst strength shall exceed 300 PSI and the ultraviolet stability shall exceed 70 percent. The sandbags shall be 24 to 30 inches in length, 16 to 18 inches in width and six (6) to eight (8) inches in thickness. Each sandbag shall weigh between 90 and 120 pounds.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Sandbags shall be placed at the locations shown on the plans, to construct a berm / dam which will intercept sediment-laden storm water runoff from disturbed areas, and detain sediment from storm water before entering the storm sewer inlets. Sand bags shall be removed after disturbed area has been permanently stabilized.

B. Sand shall be placed in the sandbag so that at least the top six (6) inches of the sandbag is unfilled to allow for proper tying of the open end. The sandbags shall be placed with their tied ends all in the same direction. Any subsequent rows of sandbags shall be offset one-half the length of the preceding sandbag row to provide a layered brick-type
arrangement. A single layer of sandbags shall be placed downstream to prevent erosion from falling water over the berm/dam.

C. The sandbag berm/dam installation shall be maintained in good condition by the Contractor. All necessary work and materials to maintain the integrity of the installation shall be provided until earthwork construction is complete and permanent erosion-control features are in place. The maintenance of the sandbag installation will not be paid for directly but is considered subsidiary to the various bid items of the contract.

D. The sandbag installation shall be inspected weekly or after each significant rainfall to determine if the installation is functioning as intended. When the accumulated silt reaches a depth of three (3) inches, the accumulated sediment deposits shall be removed and deposited at approved sites in a manner that will not contribute to additional siltation.

END OF SECTION 015770
SECTION 015780 – GROUND AND SURFACE WATER CONTROL

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.

B. Protecting work against surface runoff and rising floodwaters.

C. Trapping suspended sediment in the discharge from the surface and ground water control systems.

1.2 REFERENCES

A. ASTM D 698 – Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³)

B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)

1.3 DEFINITIONS

A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.

1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.

B. Excavation drainage: includes keeping excavations free of surface and seepage water.

C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.

D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.
1.4 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify ground water conditions and to provide parameters for design, installation, and operation of ground water control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.

B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 02260 – Trench Safety Systems, to produce following results:
   1. Effectively reduce hydrostatic pressure affecting:
      a. Excavations
      b. Tunnel excavation, face stability or seepage into tunnels
   2. Develop substantially dry and stable subgrade for subsequent constructions operations
   3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work
   4. Prevent loss of fines, seepage boils, quick condition, or softening of foundation strata
   5. Maintain stability of sides and bottoms of excavations

C. Provide ground water control systems that include single-stage or multiple stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from other sources, from entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.

H. Install an adequate number of piezometers installed at proper locations and depths, as necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.5 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittals Procedures.
B. Submit Ground Water and Surface Water Control Plan for review by Project Manager prior to start of excavation work. Include the following:

1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control

2. Names of equipment Suppliers and installation Subcontractors

3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures

4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics

5. Description of proposed filters including types, sizes, capacities and manufacturer’s application recommendations

6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.

7. Operating requirements, including piezometric control elevations for dewatering and depressurization

8. Excavation drainage methods including typical drainage layers, sump pump application and other means

9. Surface water control and drainage installations

10. Proposed methods and locations for disposing of removed water

C. Submit following records upon completion of initial installation:

1. Installation and development reports for well points, eductors, and deep wells

2. Installation reports and baseline readings for piezometers and monitoring wells

3. Baseline analytical test data of water from monitoring wells

4. Initial flow rates

D. Submit the following records weekly during control of ground and surface water operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.2, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers and monitoring wells
1.6 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain necessary permits from agencies with jurisdiction over use of ground water and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.

D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Project Manager through submittals required in Paragraph 1.6, Submittals.

B. Use experienced contractors, who are regularly engaged in ground water control system design, installation, and operation, to furnish, install and operate eductors, well points, or deep wells, when needed.

C. Maintain equipment in good repair and operating condition.

D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.

1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART 3 – EXECUTION

3.1 GROUND WATER CONTROL

A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary, to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in a manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Project Manager in writing of changes made to
accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.

F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.

G. Removal of ground water control installations.
   1. Remove pumping system components and piping when ground water control is no longer required.
   2. Remove Piezometers, including piezometers installed during design phase investigations and left for contractor’s use, upon completion of testing as required in accordance with Part 3 of applicable specification.
   3. Remove monitoring wells when directed by Project Manager.
   4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hours after placement.

I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.

J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.

K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.

M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.
3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.

B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.

C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.

D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change method of control, if ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.6B.

3.3 SEDIMENT TRAPS

A. Install sediment tank as shown on approved plan.

B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

3.4 SEDIMENT SUMP PIT

A. Install sediment sump pits as shown on approved plan.

B. Construct standpipe by perforating 12-inch to 24-inch diameter corrugated metal or PVC pipe.

C. Extend standpipe 12 inches to 18 inches above lip of pit.

D. Convey discharge of water pumped from standpipe to sediment trapping device.

E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.5 EXCAVATION DRAINAGE

A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells, to maintain stable excavation and backfill conditions.
3.6 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations.

D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Project Manager.

3.7 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Project Manager determines more frequent monitoring and recording are required. Comply with Project Manager’s direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

3.8 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION 015780
SECTION 017419 - 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.

B. Related Requirements:
   1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions TPWD.
   2. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
   3. Section 042016 "Reinforced Unit Masonry" for disposal requirements for masonry waste.
   4. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

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 PERFORMANCE REQUIREMENTS

A. IT IS THE GOAL FOR TPWD TO MINIMIZE THE DEMOLITION AND CONSTRUCTION WASTE MATERIALS THAT GO TO A LANDFILL. To accomplish this, the Contractor shall review the removed materials and waste materials for potential recycling.

B. General: 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 that can be recycled in the Galveston area including the following:

1. Demolition Waste:
   a. Asphalt paving.
   b. Concrete.
   c. Concrete reinforcing steel.
   d. Concrete masonry units.
   e. Plumbing fixtures.
   f. Piping.
   g. Electrical conduit.
   h. Copper wiring.
   i. Lighting fixtures.
   j. Lamps.
   k. Ballasts.
   l. Electrical devices.
   m. Switchgear and panelboards.
   n. 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.
      7) Plastic pails.
1.5 ACTION SUBMITTALS
   A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 QUALITY ASSURANCE
   A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 WASTE MANAGEMENT PLAN
   A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification and waste reduction work plan.
   B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
   C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
      1. 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.
      2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
      3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
      4. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION
   A. General: 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.
   B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
      1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

D. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic areas of the site by 10 feet or more.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.
5. 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 Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. 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.

C. Procedures: 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.

1. 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.

   a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Store components off the ground and protect from the weather.
4. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE
A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

3.5 RECYCLING CONSTRUCTION WASTE
A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

3.6 DISPOSAL OF WASTE
A. General: 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. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419
SECTION 024119 - SELECTIVE 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 structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

B. Related Requirements:
   1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions for projects administered by the TPWD
   2. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse or storage.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 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 provide demolition as indicated without disturbing historic items and areas of the site.

1.5 PREINSTALLATION MEETINGS

A. Predemolition 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 requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. 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. 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.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of the site.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, that might be misconstrued as damage caused by demolition operations.

1.7 FIELD CONDITIONS

A. Owner will occupy portions of the site immediately adjacent to selective demolition area. Conduct selective demolition so Owner’s operations will not be disrupted.

B. Notify Construction Manager and Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Construction Manager and Owner. Hazardous materials will be removed by Owner under a separate contract.
D. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that avoid historic areas of the site.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.8 COORDINATION
A. Arrange selective demolition schedule so as not to interfere with Owner’s operations.

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 ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS
A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of the site.
3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to items to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability of trenches.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 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. 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. Temporarily cover openings to remain.
   2. Dispose of demolished items and materials promptly.

B. 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.

C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic.

D. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

E. Existing Items to Remain: Protect construction indicated to remain against damage during selective demolition. When permitted by Construction Manager, 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.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Asphalt and Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

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.

B. Burning: Do not burn demolished materials.

3.7 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 024119
PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes all labor, materials and equipment required to form all cast-in-place concrete shown on the drawings, including but not limited to all foundations, sidewalks, and equipment pads.

1.2 REFERENCE STANDARDS

A. RE: Structural Engineer’s Sheet S0.00, Section 4: REINFORCING STEEL and Section 8: REINFORCE CONCRETE for Standards.

1.3 DESIGN OF THE FORM

A. Design, erect, support, brace & maintain formwork so that it will safely support all lateral loads that might be applied

B. Support form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to assure a smooth completed surface, free from irregularities, and within the allowable tolerances. Final position of all structural members shall be at elevations shown on drawings.

C. Design formwork to be readily removable without impact, shock or damage to the cast-in-place concrete surfaces and adjacent materials.

D. Provide formwork sufficiently tight to prevent leakage during concrete placement. Solidly butt all joints and provide backup material at joints as necessary to prevent leakage and fins.

PART 2 – PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Unless otherwise specified, formwork for exposed concrete surfaces as noted on the Drawings, shall consist of plywood, metal, metal framed plywood, or other acceptable surface. Furnish in the largest practicable sizes to minimize number of joints. Provide a continuous straight smooth surface conforming to the joint system as specified on the drawings. Form material shall have sufficient thickness to withstand pressure of concrete without bow or deflection.

B. Plywood shall be exterior grade plywood panels, suitable for concrete forms, complying with U.S. Product Standard PS-1, B-B high density overlaid concrete form, Class 1, or better, mill oiled and edged sealed.

2.2 FORM TIES

A. Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to prevent defect, and spalling of concrete upon removal.
B. Unless otherwise shown, provide ties so that portion remaining within concrete after removal of exterior form is at least 1 ½ inch from outer concrete surface. The ties shall leave holes no larger than 1 inch in diameter in concrete surfaces when the ends or end-fasteners are removed.

2.3 FORMWORK COATINGS

A. Formwork coatings shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bonding or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2.4 NAILS AND FASTENERS

A. Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces such as porches and exterior storage rooms.

PART 3 - EXECUTION

3.1 FORM CONSTRUCTION

A. Construct forms to sizes, shapes, grades and dimensions shown, level and plumb. Provide for openings, offsets, sinkages, keyways, recesses, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work.

B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

C. If required, provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and patch forms to prevent loss of concrete. Locate temporary openings on forms at inconspicuous locations.

D. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades.

E. Carefully form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete. Back joints with extra studs or girts as required to maintain true and square intersections.

F. Do not use metal cover plates for patching holes or defects in forms.

3.2 CLEANING AND TIGHTENING

A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just prior to concrete placement. Retighten forms and bracing prior to concrete placement as required to prevent leaks and maintain proper alignment.
3.1 PREPARATION OF FORM SURFACES

A. All surfaces of form and embedded materials shall be cleaned of any accumulated mortar or grout residues, or any other foreign material before concrete is placed.

B. Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Thin form-coating compounds only per the form-coating compound manufacturer’s directions.

C. Do not allow excess form coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed.

3.2 INSTALLATION OF EMBEDDED MATERIAL

A. Set and build into the form anchorage devices and other embedded items required by other work that is attached to or supported by concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.

B. Edge forms and screed strips: Set edge form or bulkheads and intermediate screed strips for slab to obtain required elevations and contours in the finished slab surface. Provide and secure units to support type of screeds required.

3.3 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated, or otherwise damaged facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

B. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

C. Forms intended for successive concrete placement: Thoroughly clean surfaces, remove fins, laitance, and tighten forms to close all joints to avoid surface offsets. Patched forms for exposed concrete surfaces are not acceptable.

3.4 REMOVAL OF FORMS

A. Formwork not supporting concrete such as sides of beams, walls, columns and similar parts of the work, may be removed 12-24 hours after placing the concrete, provided the concrete is sufficiently hardened to not be damaged by the form removal operations, and provided that curing and protection operations are maintained.

B. Form facing material may be removed 4 days after placement, only if the shores and other vertical supports have been arranged to permit removal of the form facing material with loosening or disturbing the shores and supports.

END OF SECTION 03 10 00
PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

A. The drawings, Division 1 Specifications, general provisions and general and supplemental conditions of the contract apply to work specified in this section.

1.2 WORK INCLUDED

A. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, welded steel wire fabric, ties and supports.

1.3 RELATED WORK

A. Section 03 30 00 - Cast-In-Place Concrete
B. Section 04 20 16 - Reinforced Unit Masonry

1.4 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise:

1. ACI 301 - Specifications for Structural Concrete for Buildings.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. AWS D1.1 - Structural Welding Code – Steel
4. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
6. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.
7. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

1.5 QUALITY ASSURANCE

A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and Documents 63 and 65.

B. The latest adopted edition of all standards referenced in this section shall apply unless noted otherwise. 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.
1.6 SUBMITTALS

A. Submit in accordance with section 01 33 00.

B. Submittals for review:
   1. Shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement".
   2. Indicate sizes, spacings, locations and quantities of reinforcing steel, wire fabric, bending diagrams, splicing, stirrup spacing, supporting and spacing devices and assemblies as required for fabrication and placement of reinforcement.
   3. Do not reproduce the structural drawings for use as shop drawings.
   4. Embedded metal assemblies: Submit shop drawings for fabrication and placement. Use standard AWS welding symbols.

C. Submittals for Information:
   1. Mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Steel:
   1. ASTM A615, grades as indicated on the drawings.

B. Galvanized reinforcing steel:
   1. ASTM A767, Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement”.

C. Reinforcing Bars to be Welded:
   1. ASTM A706, "Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement".

D. Welded Steel Wire Fabric:
   1. ASTM A185, "Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement." Furnish in flat sheets, not rolls.

2.2 ACCESSORIES

A. Tie Wire:
   1. Minimum 16 gage, annealed type.
B. Chairs, Bolsters, Bar Supports, Spacers:
1. Sized and shaped for strength and support of reinforcement during installation and placement of concrete in conformance with CRSI recommendations.
2. For slabs on grade, provide sand plates, horizontal runners, or precast concrete blocks on bottom where base material will not support chair legs or where vapor barrier has been specified.

C. Chairs, Bolsters, Bar Supports, Spacers adjacent to exposed to view concrete surfaces:
1. Provide supports with plastic coated legs (CRSI, Class 1), or stainless steel protected legs (CRSI, Class 2).

2.3 EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates:
1. Conform to ASTM A36

B. Headed Studs:
1. Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.

C. Welded Deformed Bar Anchors:
1. Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

D. Reinforcing Bars to be Welded:
1. ASTM A706.

2.4 MECHANICAL SPLICES

A. Provide mechanical splices designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the smaller bar being spliced. The following splicing systems are acceptable:

1. Erico “Cadweld C-Series”
2. Erico “Lenton”
3. Dayton Barsplice “Bar-Grip”
4. Dayton Barsplice “Grip-Twist”

2.5 DOWEL BAR ANCHORS

A. Provide dowel bar anchors and threaded dowels designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the dowel bars. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by the 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”
2.6 COATINGS
   B. Cold Galvanizing Compound for field repair of galvanizing: "ZRC Cold Galvanizing Compound" by ZRC Chemical Products Company, Quincy, Massachusetts.

2.7 FABRICATION OF REINFORCEMENT
   A. Fabricate with tolerances complying with CRSI "Manual of Standard Practice."
   B. Weld reinforcing bars in accordance with ANSI/AWS D1.4.

2.8 FABRICATION OF EMBEDDED METAL ASSEMBLIES
   A. Fabricate metal assemblies in the shop. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.
   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. A minimum of two headed studs shall be tested at the start of each production period for proper quality control. The studs shall be capable of being bent 45 degrees without failure.
   C. Welding of reinforcement shall be done in accordance with AWS D1.4, using the recommended preheat temperature and electrode for the type of reinforcement being welded. Bars larger than no. 9 shall not be welded. Welding shall be subject to the observance and testing of the Testing Laboratory.
   D. Metal assemblies exposed to earth, weather or moisture shall be hot dip galvanized. All other metal assemblies shall be either hot dip galvanized or painted with epoxy paint. Repair galvanizing after welding with a Cold Galvanizing compound installed in accordance with the manufacturer's instructions. Repair painted assemblies after welding with same type of paint.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Before placing concrete, clean reinforcement to remove soil, loose rust, mill scale, ice, or other materials which reduce bond with concrete.
   B. Accurately position reinforcement and secure reinforcement against displacement by construction or concrete placement operations.
   C. Place reinforcement to obtain minimum concrete cover specified. Tie bars and bar supports together with tie wire to hold reinforcement in position. Set tie wires so that the twisted ends are directed away from exposed concrete surfaces.
   D. Installation tolerances:
      1. Top and bottom bars in slabs, girders, beams and joists:
         a. Members 8" deep or less: ±3/8"
         b. Members more than 8" deep: ±1/2"
2. Concrete Cover to Formed or Finished Surfaces:
   a. Members 8" deep or less: ±3/8"
   b. Members more than 8" deep: ±1/2"; except that tolerance for cover shall not exceed 1/3 of the specified cover.

E. Concrete Cover: refer to the Structural Notes.

F. Welded Wire Fabric:
   1. Lap adjoining pieces at least one full mesh and lace splices with tie wire.

G. Splices:
   1. Provide standard reinforcement splices by lapping and tying ends.
   2. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.
   3. No. 14 and 18 bars shall not be lap spliced.

H. Mechanical Splices:
   1. Use for splicing of bars larger than no. 11 or where no. 11 bars are spliced to larger size bars and where indicated on the drawings.
   2. Comply with manufacturer's instructions for preparation of bars and installation procedures.

I. Welding of Reinforcing Steel:
   1. Comply with the requirements of AWS D1.4 for field welding.
   2. Only steel conforming to ASTM A706 may be welded.

J. Field Welding of Embedded Metal Assemblies:
   1. All paint and galvanizing shall be removed in areas to receive field welds.
   2. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.

END OF SECTION 032000
SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.

1.02 SUMMARY

A. This section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
B. Concrete paving and walks are specified in Division 32.
C. Mechanical finishes and concrete floor toppings are specified in other Division 3 sections.

1.03 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division 1 Specification sections.
B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waters-tops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Architect.
D. Samples of materials as requested by Architect, including names, sources, and descriptions, as follows:
   1. Normal weight aggregates.
   2. Fibrous reinforcement.
   3. Reglets.
   5. Vapor retarder.
E. Laboratory test reports for concrete materials and mix design test.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
   1. ACI 318, Building Code Requirements for Reinforced Concrete.
   2. Concrete Reinforcing Steel Institute (CRSI), Manual of Standard Practice.
B. Concrete Testing Service: Engage a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.
C. Materials and installed work may require testing and retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete:
   1. Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

B. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

C. Forms for Unexposed Finish Concrete:
   1. Plywood, lumber, metal, or other acceptable material.
   2. Provide lumber dressed on at least 2 edges and one side for tight fit.

D. Form Coatings:
   1. Provide commercial formulation form-coating compounds with a maximum VOC of 350 mg/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

E. Form Ties:
   1. Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal.
   2. Provide units that will leave no metal closer than 1-1/2 inches to exposed surface.
   3. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Steel Wire: ASTM A82, plain, cold-drawn steel.


E. Supports for Reinforcement:
   1. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place.
   2. Use wire-bar- type supports complying with CRSI specifications.
F. Slabs-on-grade:
   1. Use supports with sand plates or horizontal runners where base material will not support chair legs.

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.
   1. Use one brand of cement throughout project unless otherwise acceptable to Architect.

B. Fly Ash: ASTM C 618, Type C or Type F.

C. Normal Weight Aggregates: ASTM C 33 and as herein specified.
   1. Provide aggregates from a single source for exposed concrete.
   2. For exterior exposed surfaces, do not use spalling-causing deleterious substances.

D. Water: Drinkable.

E. Admixtures General: Provide admixtures for concrete that contain no more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
   1. Available Products: Subject to compliance with requirements, products incorporated in the work include, but are not limited to, the following:
      c. "Darex AEA" or "Daravair," W.R. Grace & Co.
      d. "MB-VR" or "Micro-Air," Master Builders, Inc.

G. Water-Reducing Admixture: ASTM C 494, Type A.
   1. Available Products: Subject to compliance with requirements, products incorporated in the work include, but are not limited to, the following:
      e. "Pozzolith Normal" or "Polyheed," Master Builders, Inc.
      g. "Plastocrete 161," Sika Corp.

H. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
d. "WRDA 19" or "Daracem," W.R. Grace & Co.
e. "Rheobuild," Master Builders, Inc.
g. "Sikament 300," Sika Corp.

I. Water-Reducing Accelerating Admixture: ASTM C 494, Type E.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
   e. "Pozzutec 20," Master Builders, Inc.

J. Water-Reducing Retardina Admixture: ASTM C 494, Type D.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
   b. "Eucon Retarder 75,
   c. "Euclid Chemical Co. "Daratard-17,
   d. "W.R. Grace & Co. "Pozzolith R,
   e. "Master Builders, Inc.

2.04 RELATED MATERIALS

A. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

B. Vapor Retarder: Provide vapor retarder cover over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154, as follows:

1. Vapor Barrier (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision.

2. Vapor Barrier membrane must have the following properties:
   a. Permeance of less than 0.01 Perms [grains/(ft² * hr * in.Hg)] per ASTM F 1249 or ASTM E 96
   b. Maintain permeance of less than 0.01 Perms [grains/(ft² * hr * in.Hg)] after mandatory conditioning tests per ASTM E 154 Sections 8,11,12, and 13.
   c. ASTM E 1745 Class A (Plastics)
C. Basis of Design: Stego Wrap 10- mil Vapor Barrier by Stego Industries LLC, 949.257.4100

D. Other Acceptable Vapor Barrier Products:


E. Seam Tape: Tape must have the following qualities:

1. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
2. Seam Tape
3. Stego Tape by Stego Industries LLC, San Clemente, CA (949) 257-4100 www.stegoindustries.com

F. Vapor Proofing Mastic: Mastic must have the following qualities:

1. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
2. Mastic
3. Stego Mastic by Stego Industries LLC, San Clemente, CA (949) 257-4100 www.stegoindustries.com

G. Pipe Boots: Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

H. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

I. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

J. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

1. Available Products: Subject to compliance with requirements, products incorporated in the work include, but are not limited to, the following:

   b. "Spartan-Cote," The Burke Co.
   e. "Day-Chem Cure and Seal," Dayton Superior Corp.
   g. "Horn Clear Seal," A.C. Horn, Inc.
   h. "L&M Cure," L & M Construction Chemicals, Inc.
   i. "Masterkure," Master Builders, Inc.
   m. "Stontop CS2," Stonhard, Inc.
K. Underlayment Compound: Free-flowing, self-leveling, pump-able, applications from one inch thick to feathered edges.

1. Available Products: Subject to compliance with requirements, products incorporated in the work include, but are not limited to, the following:
   c. "LevelLayer II," Dayton Superior Corp.
   d. "Flo-Top," Euclid Chemical Co.
   e. "Levelex," L&M Construction Chemicals, Inc.
   g. "Stoncrete UL1," Stonhard, Inc.

L. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Available Products: Subject to compliance with requirements, products incorporated in the work include, but are not limited to, the following:
   g. "Everbond," L & M Construction Chemicals, Inc.
   h. "Acryl-Set," Master Builders Inc.

M. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material Type, Grade and Class to suit project requirements.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
   a. "Burke Epoxy M.V.," The Burke Co.
   c. "Euco Epoxy System #452 or #620," Euclid Chemical Co.
   e. "Epabond," L&M Construction Chemicals, Inc.
   g. "Sikadur 32 Hi-Mod," Sika Corp.

2.05 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

1. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs.

2. The testing facility shall not be the same as used for field quality control testing.
3. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work.
   1. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
   1. 4000-psi, 28-day compressive strength; W/C ratio, 0.51 maximum (non-air-entrained), 0.41 maximum (air-entrained), or, if approved in writing by the Structural Engineer, the following:
   2. 3000-psi, 28-day compressive strength; W/C ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained), or, if approved in writing by the Structural Engineer, the following:
   3. 2500-psi, 28-day compressive strength; W/C ratio, 0.67 maximum (non-air-entrained), 0.54 maximum (air-entrained).

D. Adjustment to Concrete Mixes:
   1. Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Structural Engineer and Materials Inspection Agency.
   2. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Structural Engineer before using in work.

2.06 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in concrete as required for placement and workability.

B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50° F (10° C).

C. Use high-range water-reducing admixture (HRWR) in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer’s prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within following limits:
   1. Use admixtures for water reduction and set control in strict compliance with manufacturer’s directions.

E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
   1. Ramps, slabs, and sloping surfaces: Not more than 6 inches.
2. Reinforced foundation systems: Not more than 6 inches.
3. Other concrete: Not more than 5 inches.

2.07 CONCRETE MIXING

A. Job-Site Mixing:
   1. Mix materials for concrete in appropriate drum-type batch machine mixer.
   2. For mixers of one cu. yd. or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   3. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd. or fraction thereof.
   4. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Ready-Mix Concrete:
   1. Comply with requirements of ASTM C 94, and as specified.
   2. When air temperature is between 85° F (30° C) and 90° F (32° C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90° F (32° C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.02 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.
   1. Maintain formwork construction tolerances complying with ACI 347.

C. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures.

D. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
E. Fabricate forms for easy removal without hammering or prying against concrete surfaces.

F. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

G. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

I. Provisions for Other Trades:
   1. Provide openings in concrete formwork to accommodate work of other trades.
   2. Determine size and location of openings, recesses, and chases from trades providing such items.
   3. Accurately place and securely support items built into forms.

J. Cleaning and Tightening:
   1. Thoroughly clean forms and adjacent surfaces to receive concrete.
   2. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed.
   3. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.03 VAPOR BARRIER INSTALLATION

A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour.

B. Install Vapor Barrier/Retarder: Installation shall be in accordance with manufacturer’s instructions and ASTM E 1643-98 (2005).
   1. Unroll Vapor Barrier/Retarder with the longest dimension parallel with the direction of the pour.
   2. Lap Vapor Barrier/Retarder over footings or seal to foundation walls.
   3. Overlap joints 6 inches and seal with manufacturer’s tape.
   4. Seal all penetrations (including pipes) per manufacturer’s instructions.
   5. No penetration of the Vapor Barrier/Retarder is allowed except for reinforcing steel and permanent utilities.
6. Repair damaged areas by cutting patches of Vapor Barrier/Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

3.04 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.

B. Avoid cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.

E. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

F. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.05 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Joint filler and sealant materials are specified in Division 7 Sections of these specifications.

F. Contraction (Control) Joints in Slabs-on-Ground:

1. Construct contraction joints in slabs-on-ground to form panels of patterns as shown.

2. Use saw cuts 1/8 inch wide by 1/4 slab depth or inserts 1/4 inch wide by 1/4 of slab depth, unless otherwise indicated.
G. Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

H. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

I. If joint pattern not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, and third bays).

J. Joint sealant material is specified in Division 7 Sections of these specifications.

3.06 INSTALLATION OF EMBEDDED ITEMS

A. General:

1. Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete.

2. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Forms for Slabs:

1. Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces.

2. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.07 PREPARATION OF FORM SURFACES

A. General:

1. Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before reinforcement is placed.

2. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed.

3. Apply in compliance with manufacturer's instructions.

3.08 CONCRETE PLACEMENT

A. Inspection:

1. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in.

2. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.
B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms:
   1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints.
   2. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

E. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

F. Do not use vibrators to transport concrete inside forms.
   1. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine.
   2. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer.
   3. Do not insert vibrators into lower layers of concrete that have begun to set.
   4. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

G. Placing Concrete Slabs:
   1. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

H. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

I. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

J. Maintain reinforcing in proper position during concrete placement.

K. Cold-Weather Placing:
   1. Comply with provisions of ACI 306 and as follows:
      a. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
L. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C) and not more than 80°F (27°C) at point of placement.

M. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

N. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

O. Hot-Weather Placing:

1. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

P. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

Q. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

R. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.

S. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Architect.

3.09 FINISH OF FORMED SURFACES

A. Rough Form Finish:

1. For formed concrete surfaces not exposed to view in the finish work or concealed by other construction.

2. This is the concrete surface having texture imparted by form-facing material used with tie holes, defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth Form Finish:

1. For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, painting, or other similar system.

2. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

3. Repair and patch defective areas with fins and other projections completely removed and smoothed.
C. Grout-Cleaned Finish:
   1. Provide grout-cleaned finish to scheduled concrete surfaces that have received smooth form finish treatment.

D. Combine one part Portland cement to 1-1/2 parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.

E. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

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

3.10 MONOLITHIC SLAB FINISHES
A. Trowel Finish:
   1. Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

B. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 20 - Fl 17. Grind smooth surface defects that would telegraph through applied floor covering system.

3.11 CONCRETE CURING AND PROTECTION
A. General:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   2. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material.
   3. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting; keep continuously moist for not less than 7 days.
C. Curing Methods:
   1. Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

D. Provide moisture curing by following methods:
   1. Keep concrete surface continuously wet by covering with water.
   2. Use continuous water-fog spray.
   3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

E. Provide moisture-cover curing as follows:
   1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive.
   2. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs as follows:
   1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).
   2. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
   3. Maintain continuity of coating and repair damage during curing period.
   4. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces:
   1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed.
   2. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces:
   1. Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.
2. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.12 REMOVAL OF FORMS

A. General:

1. Formwork not supporting weight of concrete, such as sides of beams, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.13 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork, penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

B. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

C. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.

D. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack before bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

F. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Architect.
3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: The Owner will employ a testing laboratory to perform tests and to submit test reports. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.

B. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

C. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

D. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.

E. Concrete Temperature: Test hourly when air temperature is 40° F (4° C) and below, when 80° F (27° C) and above, and each time a set of compression test specimens is made.

F. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed.

   1. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.

G. Compressive Strength Tests:

   1. ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. more than the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

   2. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

   3. When total quantity of a given class of concrete is less than 50 cu. yds., Architect may waive strength test if adequate evidence of satisfactory strength is provided.

   4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

   5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

H. Test results will be reported in writing to Architect, Structural Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix...
proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

I. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

J. Additional Tests:

1. The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect.

2. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION 033000
SECTION 042016 – REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including general and supplementary conditions and Division-1 Specification sections, apply to work of this section.

B. Requirements of Section "Unit Masonry" apply to work of this section.

1.2 DESCRIPTION OF WORK

Extent of each type of reinforced unit masonry work is indicated on drawings and in schedules. Provide all labor, materials, equipment, and services necessary for and incidental to the installation of all reinforced masonry construction as indicated on the drawings and specified herein. Reinforced unit masonry construction includes reinforced concrete masonry including concrete filled masonry beams, columns, pilasters, lintels, and soffits as well as brick used as forms and reinforced between wythes. Accessories include, but are not necessarily limited to ties, horizontal and vertical reinforcement, anchors to the structure, and control joints.

1.3 SUBMITTALS

A. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel required for project.

B. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars and for steel templates for layout of dowels for columns and pilasters. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Refer to Section "Unit Masonry" for masonry materials and accessories not included in this section.

B. Reinforcement Bars: Provide deformed bars complying with ASTM A 615, Grade 60.

1. Shop fabricates reinforcement bars which are shown to be bent or hooked.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Section "Unit Masonry" for general installation requirements of unit masonry.
3.2 PLACING REINFORCEMENT

A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 8'-0" with a minimum clearance of 1/4" from the face of the masonry and not less than one bar diameter or 1" (whichever is greater) between adjacent bars.

C. For columns, piers and pilasters provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2", whichever is greater. Provide lateral ties as indicated.

D. All dowels shall be grouted into a cell even if the dowel is in an adjacent cell to the vertical steel. Unless detailed otherwise on the drawings, dowels shall be the same size and number as the vertical steel. Unless noted otherwise provide a lap length of dowels to vertical reinforcement equal to 50 times the nominal dowel diameter. Dowels for columns and pilasters shall be set using 1/8" thick steel plate templates. Templates shall be detailed and submitted with reinforcing steel shop drawings.

E. All horizontal reinforcing steel shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Maintain a minimum of one bar diameter or 1" (whichever is greater) clearance between adjacent bars and a minimum of 1/4" clearance from the face of the masonry. Horizontal reinforcement may be placed as the masonry work progresses.

F. Splice reinforcement bars as required. Where splices occur, adjacent splices shall be staggered so that no more than 25% of the total numbers of bars are spliced at any one point with a minimum stagger between splices in adjacent bars of at least the lap length. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Minimum lap splice length shall be 50 bar diameters unless indicated otherwise.

G. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.

3.3 FORMWORK

A. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

B. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.

C. Formwork shall be designed and shop drawings prepared by a registered professional engineer in the state where the project is located.

D. Formwork shall not be removed until the reinforced masonry member has cured sufficiently to carry its own weight and any other loads that may be placed on it during
Construction. Allow not less than the following minimum time to elapse after completion of the member before removing shores or forms provided adequate curing conditions have been obtained during the curing period:

1. Lintels and beams - 10 days.
2. Reinforced masonry soffits - 7 days.
3. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads. Allow an additional 48 hours before applying concentrated loads such as girders, beams, or trusses.

3.4 INSTALLATION OF REINFORCED BRICK MASONRY

A. Mortar Jointing and Bedding:

1. Lay exterior wythes with bed (horizontal) and head (vertical) joints between units completely filled with mortar. Top of bed joint mortar may be sloped toward center of walls. Butter ends of units with sufficient mortar to completely fill head joints and shove into place. Do not furrow bed joints or slab head joints. Remove any mortar fins which protrude into grout space.

   a. Maintain joint widths shown for head and bed joints, except for minor variations required to maintain pattern bond. If not shown, lay with 3/8" head and bed joints.

2. Two-Wythe Wall Construction: Lay both wythes as previously specified for exterior wythes. Maintain grout space (collar or continuous vertical joint between wythes) of width indicated, but adjust, if required, to provide grout space not less than 1/2" wider than the sum of the vertical and horizontal (if any) reinforcement bars shown to be placed in grout space. Do not parge or fill grout space with mortar.

B. Low-Lift Grouting:

1. Low lift grouting is defined as the placing of reinforcement, laying of masonry units, and pouring of grout in very limited vertical increments (Ref ACI 531 Masonry Structures Building Code Commentary, Table 6-1).

2. The limitations on the use of low-lift grouting shall be as defined in Table 6-1 of ACI 531 Masonry Structures Building Code Commentary.

3. Use low-lift grouting technique with "Fine Grout" per ASTM C 476 for the following:

   a. Two-wythe walls with grout space of 2" or less in width.

4. At Contractor's option, low-lift grouting technique may be used for reinforced masonry construction with grout spaces wider than 2", except use "Coarse Grout" mix per ASTM C 476 and place in lifts not to exceed 8" in height.

5. Construct low-lift masonry by placing reinforcement, laying masonry units and pouring grout as the work progresses. All grout cores shall be clean of mortar and drippings and other deleterious material.
6. Place vertical reinforcement bars and supports prior to lying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Horizontal reinforcement bars may be placed progressively with laying of masonry units.

7. Limit grout pours as required to prevent displacement of masonry by grout pressures (blowout).

8. Lay masonry units prior to each grout pour, but do not construct more than 12" above maximum grout pour height in one exterior wythe and 4" above in other exterior wythe. Provide metal wall ties if required to prevent blowouts.

9. Pour grout using container with spout and consolidate immediately by rodding or puddling; do not use trowels. Place grout continuously; do not interrupt pouring of grout for more than one hour. If poured in lifts, place from center-to-center of masonry courses. Terminate pour 1-1/2" below top of highest course in pour.

C. High-Lift Grouting:

1. High-lift grouting is defined as the placing of reinforcement and laying of masonry units in full story heights prior to pouring of grout by pumping.

2. The limitations on the use of high-lift grouting shall be as defined in Table 6-1 of ACI 531 Masonry Structures Building Code.

3. High-lift grouting technique may be used for the following masonry construction.
   a. Two-wythe walls with grout spaces of 2-1/2" or greater width.

4. Reinforcing steel must be placed prior to grouting. Place reinforcing bars before or after laying masonry units as required by job conditions. If bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcing bar, pull loop and bar to proper position and tie free ends. Place horizontal beam reinforcement as the masonry units are laid.

5. Contractor shall provide and detail on the shop drawings additional horizontal reinforcement from that shown on the drawings as required to resist grout pressures without blowouts, rupture of CMU face shells, or displacement of units. The responsibility for the sizing and adequacy of such reinforcing shall rest exclusively with the Contractor.

6. Construct high-lift masonry by laying masonry to full height and width prior to placing of grout. Provide cleanout holes in first course of masonry along the foundation, over all bond beams, door headers, or other openings. Use high-pressure water jet stream to remove excess mortar from reinforcement bars and top surface of structural members which support wall. Clean grout spaces daily during construction of masonry.

7. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dirt, dust, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper positioning. Clean top surface of structural members supporting masonry to ensure bond. After cleaning and inspection, close cleanout holes with matching masonry units and brace closures to resist grout pressures.
8. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure, but not less than 3 days curing time. Install shores and bracing, if required, before starting grouting operations.

9. Place grout by pumping into grout spaces, unless alternate methods are acceptable to Architect.

10. Use "Coarse Grout" per ASTM C 476. Rod or vibrate each grout lift during placing and again after excess moisture has been absorbed, but before plasticity is lost. Do not penetrate or damage grout placed in previous lifts or pours.

11. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Limit pours so as not to exceed the capacity of masonry to resist displacement or loss of mortar bond due to grout pressures.
   a. Do not exceed 12 feet pour height.
   b. Do not exceed 25 feet horizontal pour dimension.

12. Where pour height exceeds 4 feet, place grout in a series of lifts not exceeding 4 feet height. Place each lift as a continuous pouring operation. Allow not less than 30 minutes, or more than one hour between lifts of a given pour.

13. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, remove temporary dams (if any), and lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence, if more pours are required.

3.5 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. General:
   1. Do not wet concrete masonry units (CMU).
   2. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed crosswebs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8" joints.

B. Walls:
   1. Pattern Bond: Lay CMU wall units in 1/2 running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
   2. Maintain vertical continuity of core or cell cavities which are to be reinforced and grouted to provide minimum clear dimensions indicated and to provide minimum clearance and grout coverage for vertical reinforcing bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

C. Columns, Piers and Pilasters:

1. Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.

2. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.

3. Where bonded pilaster construction is shown, lay wall and pilaster units together to maximum pour height specified.

D. Grouting:

1. General
   a. Use "Fine Grout" per ASTM C 476 for filling spaces less than 4" in one or both horizontal directions.
   b. Use "Coarse Grout" per ASTM C 476 for filling 4" spaces or larger in both horizontal directions.
   c. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

2. Low-Lift Grouting:
   a. Provide minimum clear dimension of 2" and clear area of 8 square inches in vertical cores to be grouted.
   b. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 feet.
   c. Lay CMU to maximum pour height. Do not exceed 5 feet height, or if bond beam occurs below 5 feet height stop pour at course below bond beam.
   d. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2" below top course of pour.
   e. Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

3. High-Lift Grouting:
   a. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3" and 10 square inches, respectively.
   b. Provide clean-out holes in the first course of masonry by omitting every other masonry unit along the foundation, over all bond beams, door
headers, or other openings. Use a high pressure water jet to remove excess mortar and drippings from grout core and from reinforcement each day during construction.

c. Do not plug clean-out holes until condition of area to be grouted has been accepted.

d. Construct masonry to full height of maximum grout pour specified, prior to placing grout.

e. Limit grout lifts to a maximum height of 5 feet and grout pour to a maximum height of 24 feet, for single wythe hollow concrete masonry walls, unless otherwise indicated.

f. Place horizontal beam reinforcement as the masonry units are laid.

g. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing shown.

h. Where lateral ties are shown in contact with vertical reinforcement bars, embed additional lateral tie reinforcement in mortar joints. Place as shown, or if not shown, provide as required to prevent grout blowout or rupture of CMU face shells, but provide not less than No. 2 bars or 8-gage wire ties spaced 16" o.c. for members with 20" or less side dimensions, and 8" o.c. for members with side dimensions exceeding 20".

4. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.

5. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.

6. Place grout by pumping into grout spaces.

7. Place grout in lintels or beams over openings in one continuous pour.

8. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1" of vertically reinforced cavities, during construction of masonry.

9. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

E. Anchoring:

1. Anchor reinforced masonry work to supporting structure as indicated.

2. Anchor reinforced masonry walls to non-reinforced masonry where they intersect, unless shown otherwise.
3.6 QUALITY CONTROL

A. Prism Strength

1. Compressive Strength, f'm. The compressive strength of reinforced concrete masonry, f'm, as determined by prism tests shall be as indicated below:

<table>
<thead>
<tr>
<th>Class of Reinforced Masonry</th>
<th>28 Day Compressive Strength, f'm</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Single Wythe Grouted Masonry</td>
<td>2500 psi</td>
</tr>
<tr>
<td>b. Multi-Wythe Grouted Masonry</td>
<td>2500 psi</td>
</tr>
</tbody>
</table>

END OF SECTION 042016
SECTION 051200 – STRUCTURAL STEEL

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 SUMMARY

A. This section includes the following:
   1. Structural steel framing members and connections.
   2. Architecturally exposed structural steel.
   3. Deck support angles.
   5. Slide bearings.
   6. Shop prime painting and touch up painting in the field.
   7. Temporary construction bracing.
   8. Fabrication and erection inspection and testing.

B. Related sections include the following:
   1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions TPWD
   2. Division 5 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the contract documents.

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
   2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.
**B. Construction:** Type PR, partially and FR, fully restrained.

**C. Construction:** Type 1, rigid frame, Type 2, simple framing and Type 3, semi-rigid framing.

### 1.5 SUBMITTALS

**A. Submit in accordance with Division 1 Section “Submittals”.

**B. Submittals for Review**

1. Provide complete details and schedules for fabrication and shop assembly of members, erection plans, details, procedures, and diagrams showing sequence of erection of structural steel components.
   
a. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   
b. Include embedment drawings.
   
c. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   
d. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.

2. Shop drawings and erection drawings shall not be made by using reproductions of contract drawings.

3. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Engineer's review shall cover general locations, spacings, and details of design. Omission from shop drawings of any materials required by the contract documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though such shop drawings may have been reviewed and returned.

**C. Submittals for Information:**

1. **Product Data:** For each type of product indicated.

2. 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.

3. **Connection Calculations:** Contractor shall design all connections not specifically detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas. Submit design calculations for the connections designed by the contractor, prior to or with the steel shop drawings. Shop drawings containing connections for which calculations have not been received shall be returned unchecked as an incomplete submittal. Calculations shall be retained for the Engineer's file and will not be approved or returned.
   
a. Connections shall be designed in accordance with the requirements specified in the structural drawings and specifications.
b. Beam connections: Submit a complete calculation for each different beam connection used and detailed on the shop drawings. Conditions which are similar may be grouped together so as to utilize a single connection design.

c. Submit complete connection calculations for wind brace connections, moment connections and other connections where specified on the contract drawings. Each calculation shall identify the location or locations for which the connection applies, the member mark(s) from the contract documents, the piece mark(s) from the shop drawings, the member size, the design loading(s), member size, and the end of the member to which the connection applies.


5. Qualification Data: For fabricator.

6. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
   a. Structural steel including chemical and physical properties.
   b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   c. Direct-tension indicators.
   d. Tension-control, high-strength bolt-nut-washer assemblies.
   e. Shear stud connectors.
   f. Shop primers.
   g. Non-shrink grout.

7. Source quality-control test reports.

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.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

C. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant.

D. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 10 years documented experience.


F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."

G. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In case of conflict between these contract documents and the referenced standard, the contract documents shall govern. In case of conflict between these contract documents and the building code, the more stringent shall govern.
H. All materials, fabrication procedures and field erection are subject to verification inspection and testing by the Owner's testing laboratory in both the shop and field. Such inspections and tests will not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with specified requirements.

I. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification to Owner's testing laboratory that welders to be employed in the work have satisfactorily passed AWS qualification tests. Recertification of welders shall be Contractor's responsibility.

J. Qualification of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used. Welding procedures shall be qualified prior to use in accordance with AWS D1.1, Part B.

K. Comply with applicable provisions of the following specifications and documents:
   1. AISC's "Code of Standard Practice for Steel Buildings and Bridges" except that the following sentence in paragraph 4.2.1 shall not apply: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as part of his preparation of these shop drawings.
   3. ASTM A6 "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
   4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
   6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   7. AWS D1.1 "Structural Welding Code"
   8. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
   9. UL "Fire Resistance Directory."

L. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 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 erosion and deterioration.

   1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
   2. 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 COORDINATION

A. Furnish 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. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles, M-Shapes, S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. All structural shapes within group 4 and 5 of the AISC grouping for tensile property classification shall be supplied using killed steel.

E. For ASTM A6 groups 4 and 5 rolled shapes, spliced or otherwise, connected by full penetration welds, provide material with Charpy V-Notch testing in accordance with ASTM A6, Supplementary Requirement S5. The impact test shall meet the minimum average value of 20 ft pounds absorbed energy at 70° Fahrenheit and shall be conducted in accordance with ASTM A673 and the AISC Specifications for Structural Steel Buildings.

F. For plates exceeding 2" thickness used in built up members, which are spliced or connected by full penetration welds, provide material with Charpy V-Notch testing in accordance with ASTM A6, Supplementary Requirement S5. The impact test shall be conducted by the producer in accordance with ASTM A673, Frequency P and shall meet a minimum average value of 20 ft pounds absorbed energy at 70° Fahrenheit.

G. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

H. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.

I. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

J. Welding Electrodes: Comply with AWS requirements.

K. Welding electrodes: AWS D1.1, E70. Welding electrodes used in full penetration welds shall have a minimum Charpy V-Notch toughness of 20 ft.-lbs at -20° Fahrenheit when tested in accordance with ASTM A6.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

1. Finish: Plain.

B. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8,) compressible-washer type. Direct –Tension indicators shall be “Load Indicator Washers” as manufactured by the Bethlehem Steel Corporation.

1. Finish: Plain.

C. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers, plain.
1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M,) Type 10.9, compressible-washer type, plain. Direct-Tension indicators shall be "Load Indicator Washers" as manufactured by the Bethlehem Steel Corporation.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Headed Anchor Rods: ASTM F 1554, Grade 36 unless noted otherwise, straight.


F. Clevises and Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.


I. Drilled expansion bolts shall be one of the following:

1. Kwik Bolt III, Hilti Fastening Systems, Tulsa, Oklahoma


2.3 PRIMER

A. Primer: SSPC-Paint 25, Type I, II, iron oxide, zinc oxide, raw linseed oil, and alkyd.

B. Galvanizing Repair Paint: ASTM A 780.

C. Cold Galvanizing Compound shall be "ZRC" cold galvanizing compound as manufactured by ZRC Chemical Products, Quincy, Massachusetts.

2.4 GROUT

A. Non-metallic, Shrinkage-Resistant Grout: ASTM C 1107, Grade B, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time, capable of developing a minimum compressive strength of 5,000 psi at 28 days.

2.5 FABRICATION


1. Camber structural-steel members where indicated.
2. Camber: Provide camber in members where indicated. Specified camber applies at the jobsite, just prior to erection, lying flat so that the member weight has no
effect. Take necessary precautions to prevent or compensate for camber loss during shipment. Measured camber in members up to 50'-0" long shall be within a tolerance of minus 1/2" to plus zero from the amount specified. For members greater than 50'-0" long, both the positive and negative tolerance may increase 1/8" for every 10'-0" of length in excess of 50'-0". Members with field measured camber outside of the specified tolerance shall be returned to the shop.

3. Mill tolerances shall conform to ASTM A6. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.

4. Mark and match-mark materials for field assembly.

5. Plates shall be free of gross discontinuities such as ruptures and de-laminations. Plates shall comply with ASTM A578, Level 1.

6. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.

2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

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, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads. Members in compression joints which depend on contact bearing shall have the bearing surfaces milled to a common plane. Members to be milled shall be completely assembled before milling.

F. Base Plates: Oversize anchor bolt holes in base plates to facilitate erection as follows:

1. Bolts 3/4" to 1" diameter: 5/16" oversize
2. Bolts 1" to 2" diameter: 1/2" oversize
3. Bolts over 2" in diameter: 1" oversize
4. Use oversize or plate washers under nut at all oversized holes in base plates. Washers must be large enough to cover the entire hole. Washer thickness shall be at least 1/8 of bolt diameter.

G. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

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.
I. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

J. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches (250 mm) o.c., unless otherwise indicated.

K. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Base-Plate 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.

2.6 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.
   2. Provide washers over all slotted holes in an outer ply.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

   1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
   3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

      a. Grind butt welds flush.
      b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

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 (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.
6. Surfaces of exposed high strength, low alloy steel members (weathering steel).
7. Top surfaces of beams which support composite metal floor deck.
8. Headed shear studs, although overspray is acceptable.

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."
2. SSPC-SP 3, "Power 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 dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Apply a 1-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 (0.038 mm).

E. Painting: Remove any visible rust that forms on blast cleaned surfaces prior to coating application by re-blasting visibly rusted areas in conformance with SSPC SP-6. Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide a uniform dry film thickness of not less than 2.5 dry mils.

### 2.8 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. Fill vent holes and grind smooth after galvanizing.

B. Galvanizing: The following steel shall be hot-dip galvanized (including any associated fasteners):

1. Lintels and shelf angles attached to structural-steel frame and located in exterior walls.
2. Cooling tower framing and supports.
3. Cooling tower screen support members and braces.
4. Railing exposed to weather.
5. Loose steel lintels.
6. All other steel outside of exterior water proofing.

### 2.9 SLIDE BEARINGS

A. Reinforced teflon, factory pre-bonded to steel plates with initial static coefficient of friction not to exceed 0.06, over a working stress range of 500 to 2000 psi. Bearing shall be one of the following:
1. "Fluorogold" slide bearings, Furon Structural Bearings Division, Furon Company, Athens, Texas
2. "Con-Slide" slide bearings, Con-Serv, Inc., East Hampton, New Jersey

2.10 SOURCE QUALITY CONTROL
   A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Refer to section 01 45 00 Testing Laboratory Services.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify elevations of concrete and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment, with steel erector present, for compliance with requirements.
   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. Design of temporary bracing and supports shall be the responsibility of the Contractor. 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 and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design," unless closer tolerances are required for proper fitting of adjoining or enclosing materials, in which case the more stringent shall apply.
      1. Set base plates for structural members on wedges, shims, or setting nuts as required.
      2. Weld plate washers to top of base plate.
      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 base plate before packing with grout.
      4. Promptly pack grout solidly between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow curing.
      5. Grout under baseplates in accordance with Section 03 30 00.
D. Align and adjust various members forming 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. Any member having a splice not shown and detailed on the accepted shop drawings shall be rejected.

F. Erection bolts shall be tightened securely and left in place unless noted otherwise on the contract drawings. Remove and fill bolt holes if exposed.

G. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

H. Do not field cut or alter structural members without approval of Architect/Engineer. Do not use thermal cutting during erection unless approved by Architect/Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

I. Gas Cutting: Do not use gas cutting torches in the field to correct fabrication errors in structural framing.

J. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

K. 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.

L. Slide Bearings: Slide bearing plates shall be permanently affixed to the member and support by welding. Member faces shall be aligned and leveled so as to maintain contact between surfaces before installing bearing plates.

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.
2. A307 bolts and high-strength (A325 and A490) bolts noted to be "snug-tight" shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into contact.
3. Faying surfaces of "slip-critical" connections, as defined in the "Specification for Structural Joints" and indicated on the drawings shall have all paint removed by blast cleaning.
4. Bolts tightened with a calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.
5. Hardened beveled washers shall be placed over slotted holes in an outer ply. Hardened beveled washers shall be used where the outer face of the bolted parts has a slope greater than 1:20 with respect to the bolt axis.
B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

2. Remove backing bars or runoff tabs, 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 of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
   a. Grind butt welds flush.
   b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in work that test reports and inspections indicate does not comply with the contract documents.

3.6 REPAIRS AND PROTECTION
A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touch-up Cold Galvanizing: Touch up areas of hot dip galvanized members where galvanizing has been abraded during shipping and erection and areas where galvanizing has been removed or damaged due to welding. Apply cold galvanizing compound in accordance with the manufacturer's instructions to a minimum dry film thickness of 2.0 mils.

C. Touch-up Painting: After installation, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories and abutting structural steel.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

D. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas with same materials as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.5 mils.

E. Touch-up Painting: Cleaning and touch-up painting are specified in Division 9 painting sections.

END OF SECTION 051200
SECTION 055000 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel items.

1.2 RELATED SECTIONS

A. Section 04 20 16 – Reinforced Unit Masonry: Placement of metal fabrications in masonry.
B. Section 09 90 00 - Paints and stains: Paint finish.

1.3 REFERENCES

G. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2004b.
H. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.
J. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2004 and errata.
K. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
M. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.4 SUBMITTALS

A. See Division 1 for Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders’ Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.5 QUALITY ASSURANCE

A. Design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Texas.

PART 2- PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A 36/A 36M.
B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
D. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
E. Welding Materials: AWS D1.1; type required for materials being welded.
F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by intermittent welds and plastic filler.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
1. Side Rails: 3/8 x 2 inches members spaced at 16 inches.
2. Rungs: 3/4 inch diameter solid round bar spaced 12 inches on center.
3. Space rungs 7 inches from wall surface.

B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.

C. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

D. Lintels: As detailed; prime paint finish.

E. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

F. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

G. Exterior Drive Swing Gate: Steel Pipe, prime paint finish

2.4 FINISHES - STEEL

A. Prime paint all steel items.

1. Exceptions: Galvanize items to be embedded in concrete or masonry.
2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A 123/A 123M requirements.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A 123/A 123M requirements.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.
3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Field weld components indicated.
C. Perform field welding in accordance with AWS D1.1.
D. Obtain approval prior to site cutting or making adjustments not scheduled.
E. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 055000
SECTION 05 51 50 – LADDERS

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Fiberglass access ladders.

1.2 SUBMITTALS

A. Products Data: Manufacturer’s data sheets on each product.

B. Shop Drawings:
   1. Detail fabrication and erection of each ladder indicated. Include plans, elevations, sections, and details of metal fabrications and their connections.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. Provide reaction loads for each hanger and bracket.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in producing ladders similar to those indicated for this Project.
   1. Record of successful in-service performance.
   2. Sufficient production capacity to produce required units.
   3. Professional engineering competent in design and structural analysis to fabricate ladders in compliance with industry standards and local codes.

B. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.

C. Product Qualification: Product design shall comply with OSHA 1910.27 minimum standards for ladders.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer’s unopened packaging until ready for installation.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurement before fabrication.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, indicate established dimensions on shop drawing submittal and proceed with fabrication.

1.6 WARRANTY

A. Manufacturer has responsibility for an extended Corrective Period for work of this Section for a period of 5 years commencing on the shipment date of the product against all the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.
1. Defects in materials and workmanship.
2. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third party testing laboratory. Ordinary wear and tear, unusual abuse or neglect excepted.
3. Within the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective ladder.

B. Manufacturer shall be notified immediately of defective products and be given a reasonable opportunity to inspect the goods prior to return. Manufacturers will not assume responsibility, or compensation, for unauthorized repairs or labor. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use of the ladder; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of ladder products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturer: McMaster – Carr; P.O. Box 4355; Chicago, IL 60680-4355 Tel: (630) 833-0300 or (630)600-3600.

2.2 APPLICATIONS/SCOPE

Fiberglass, 500 lbs capacity, 9'-9" Climbing height, 13'-3" overall height. 28" wide; weight 52 lbs; 10 steps; grit coated; 42" grab post; 7" projection; yellow; mounting hardware included; 4 mounting holes. Meets OSHA Standards. Verify height required before ordering. 90 degree incline.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.

B. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.

C. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
3.3 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 05 51 50
DIVISION 06   WOOD, PLASTICS, AND COMPOSITES

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 – GENERAL

1.1 SCOPE

A. The Work of this Section includes:
   1. Framing with dimensional lumber.
   2. Framing with engineered wood products.
   3. Wood blocking and nailers.
   4. Wood connections.
   5. Sheathing.
   6. Vapor Retarder.

B. Related Documents: Refer to Structural Drawings for additional requirements.

PART 2 – PRODUCTS

2.1 LUMBER: Refer to Structural Drawings, S5.00

2.2 GLUED-LAMINATED BEAMS: Refer to Structural Drawings, S5.00

2.3 PRESERVATIVE-TREATED MATERIALS: Refer to Structural Drawings, S5.00

A. AWPA C2 lumber and AWPA C9 plywood, labeled by an inspection agency approved by ALSC’s Board of Review. After treatment, kiln-dry lumber and plywood to 19 and 15 percent moisture content, respectively. Treat indicated items and the following:
   1. Wood members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Concealed members in contact with concrete.
   3. Wood framing members less than 18 inches (460 mm) above grade.
   4. Wood sill plates installed over concrete slabs directly in contact with earth.

2.4 PANEL PRODUCTS: Refer to Structural Drawings.

2.5 VAPOR RETARDER

A. Tyvek, or equal: Unperforated polyolefin material complying with ASTM 1677, Type 1, with minimum or maximum water-vapor transmission of 10 perms.

B. Other products (e.g. tapes) required for complete air-infiltration barrier system per code

2.6 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.
   2. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
B. Metal Framing Anchors: Hot-dip galvanized steel of structural capacity, type, and size indicated by Structural Engineer.

C. Sill-Sealer:
1. Glass-fiber insulation, 1-inch thick, compressible to 1/32 inch to be used at sills at exterior walls.

D. Adhesives for Field Gluing Panels to Framing: APA AFG-01.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with specifications provided by Structural Engineer on Structural Drawings.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut and fitted.

C. Fit rough carpentry to other construction; scribe and cope for accurate fit. Correlate location of furring, blocking, and similar supports to allow attachment of other construction.

D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated by Structural Engineer on Structural Drawings.

E. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

F. Countersink nail heads on exposed carpentry work for filler.

G. Framing Standard: Comply with APA Manual for Wood Frame Construction unless otherwise indicated.

H. Air Infiltration Barrier System:
1. Apply Vapor retarder over wall sheathing per manufacturer's instructions and as required per code.

END OF SECTION 06 10 00
SECTION 061533 - WOOD 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. Wood decking.
      2. Wood benches.

1.3 DEFINITIONS
   A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater in
      width.
   B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in
      least dimension.
   C. Timber: Lumber of 5 inches nominal or greater in least dimension.
   D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
      1. NLGA: National Lumber Grades Authority.
      2. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS
   A. Product Data: For preservative-treated wood products and metal framing anchors.
      1. For preservative-treated wood products. Include chemical treatment manufacturer's
         written instructions for handling, storing, installing, and finishing treated material.
      2. For metal framing anchors. Include installation instructions.
   B. Samples: For decking, not less than 24 inches long, showing the range of variation to be
      expected in appearance of decking, including surface texture.
   C. Mock-Ups: For boardwalks construct 10 linear feet complete for approval prior to proceeding
      with the work.
1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Handle and store engineered lumber to comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

1. Factory mark each item with grade stamp of grading agency.
2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 19 percent.
2. Dimension Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness 15 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness.
3. Timber. 19 percent.
2.2 WOOD DECKING

A. Hand select wood for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

B. Dimension Lumber Decking: No. 1 grade Treated Pine

2.3 WOOD RAILINGS

A. Hand select wood for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

B. Dimension Lumber Railing Members: No. 1 grade Treated Pine

2.4 WOOD BENCHES

A. Dimension Lumber for Benches: No. 1 grade Treated Pine

2.5 DIMENSION LUMBER FRAMING

A. Deck Framing: Select Structural grade and the following species:
   1. Southern pine; SPIB.

2.6 PRESERVATIVE TREATMENT

A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.

C. Pressure treat poles with waterborne preservative according to AWPA U1; Use Category UC4a.

D. Preservative Chemicals: Acceptable to authorities having jurisdiction.

   1. Do not use chemicals containing arsenic or chromium.

E. Use process for boards and dimension lumber that does not include water repellents or other substances that might interfere with application of indicated finishes.

F. After treatment, redry dimension lumber to 19 percent maximum moisture content.

G. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC’s Board of Review.
1. For items indicated to receive a stained or natural finish, mark each piece on surface that will not be exposed or omit marking and provide certificates of treatment compliance issued by inspection agency.

### 2.7 FASTENERS

**A. General:** Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Use stainless steel unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless-steel fasteners.
3. For wood decking, use stainless-steel fasteners.

**B. Nails: Not Permitted**

**C. Power-Driven Fasteners:** ICC-ES AC70.

**D. Wood Screws and Lag Screws:** ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

**E. Stainless-Steel Bolts:** ASTM F 593, Alloy Group 1 or 2; with ASTM F 594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

**F. Postinstalled Anchors:** Stainless-steel, torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

**A.** Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

**B.** Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

**A.** Clean substrates of projections and substances detrimental to application.
3.3 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install wood decking with crown up (bark side down).

D. Secure decking to framing with deck clips.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

I. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.

J. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered. Patterns to be determined in mock-up.

3.4 ELEVATED DECK JOIST FRAMING INSTALLATION

A. General: Install joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists where framed into wood supporting members by using wood ledgers as indicated or, if not indicated, by using metal joist hangers. Do not notch joists.

B. Provide solid blocking of 2-inch nominal thickness by depth of joist at intervals of 96 inches o.c., between joists.

3.5 RAILING INSTALLATION

A. Balusters: Fit to railings, screw in place. Countersink fastener heads, fill flush, and sand filler.

B. Railings: Secure wall rails with metal brackets. Fasten freestanding railings to newel posts and to trim at walls with countersunk-head wood screws or rail bolts and glue.
SECTION 06 17 53 – SHOP-FABRICATED WOOD TRUSSES

PART I – GENERAL

1.1 SECTION REQUIREMENTS

A. Scope: Engineer, fabricate, and erect metal-plate-connected wood trusses to withstand design loads without exceeding deflection limits of ANSI/TPI 1, “National Design Standard for Metal-Plate-Connected Wood Truss Construction.”

B. Submittals:
1. Product Data
2. Shop Drawings
3. Structural Analysis Data: Signed and sealed by a qualified professional engineer engaged by the fabricator who is registered in the state where Project is located.

C. Quality Assurance: Engage a fabricator who participates in a recognized quality-assurance program that involves inspection by an independent inspecting and testing agency acceptable to authorities having jurisdiction.

D. Reference Standards: Comply with
1. ANSI/TPI 1.
2. TPI HIB, “Commentary and Recommendations for Handling Installing & Bracing Metal Plate Connected Wood Trusses.”

PART 2 – PRODUCTS

2.1 MATERIALS

A. Metal-plate-connected Wood Trusses: Comply with Structural Engineer’s requirements & specifications, RE: Structural Drawings.

2.2 FABRICATION

A. Fabricate wood trusses within manufacturing tolerances of ANSI/TPI 1 and connect truss members by metal connector plates.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install and brace trusses according to recommendations of and tolerances of ANSI/TPI 1. Space trusses as indicated; install plumb, square, and true to line; and securely fasten to supporting construction.
B. Anchor trusses securely at all bearing points using metal framing anchors and fasten securely.

C. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses.

D. Install and fasten permanent bracing during truss erection. Anchor ends of permanent bracing where terminating at walls or beams.

E. Do not alter, cut, or remove truss members.

F. Remove and replace wood trusses that are damaged or deficient.

END OF SECTION 06 17 53
SECTION 06 20 00 – INTERIOR FINISH CARPENTRY

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Scope: The work of this section includes:
   1. Interior standing and running trim
   2. Wood sills.

B. Related Documents: Refer to A.810 Finish schedule for material locations.

C. Reference Standards:
   1. ANSI A208.2-2016 Medium Density Fiberboard (MDF) for Interior Applications
   2. HPVA HP-1, “Interim Voluntary Standard for Hardwood and Decorative Plywood.”
   3. NHLA American Hardwood Lumber Grades

PART 2 – PRODUCTS

2.1 INTERIOR STANDING AND RUNNING TRIM): Provide finished lumber and moldings complying with the following requirements:

A. Casing (CA-1): Formaldehyde-free MDF, ¾” X 2”, Square
B. Casing (CA-2): 1”x4” Fiber Cement

2.2 WOOD SILLS

A. Sill: Paint-grade Hardwood
   1. No. 1 Common poplar, or equal.
   2. ¾” thick, Square edges

2.3 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.

PART 3 - EXECUTION

3.1 PREPARATION: Condition finish carpentry to average prevailing humidity conditions in installation areas for a minimum of 24 hours before installation.
3.2 INSTALLATION

A. Install finish carpentry plumb, level, true, and aligned with adjacent materials. Use concealed shims where required for alignment. Scribe and cut finish carpentry to fit adjoining work.

B. Standing and Running Trim: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Fill gaps, if any, between top of base and wall with plastic wood filler and sand smooth. Cope at returns and miter at corners.

3.3 ADJUSTING AND REPAIRING

A. Adjust joinery for uniform appearance.

B. Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry.

3.4 CLEANING: Comply with requirements for surface preparation and application in Section 09 90 00 Painting and Staining.

3.5 Standing and Running Trim: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Fill gaps, if any, between top of base and wall with plastic wood filler and sand smooth. Cope at returns and miter at corners.

3.6 Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

END OF SECTION 06 20 00
SECTION 06 40 00 – ARCHITECTURAL CASEWORK AND COUNTERTOPS

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Scope: the work of this section includes all cabinets, countertops, wood supports, blocking, shims, and hanging strips, unless concealed within other construction prior to woodwork installation.

B. Related Documents: Refer to A.810 Finish Schedule for material locations.

C. Submittals:
   1. Shop Drawings: Millwork cabinets.
   2. Samples
      a. Countertop materials
      b. Edge band


E. Environmental Limitations: Do not deliver or install casework and countertops until building is enclosed, wet work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 PRODUCTS

2.1 SPRAY PAINTED CABINETS (M-1):

A. Grade: Paint

B. Construction: Frameless

C. Door Interface: Flush overlay.

D. Edge Profile: Square edge with thin applied edge band. Coordinate with exterior finish.

E. Cabinets, drawers, and adjustable shelves as indicated in interior elevation Drawings.

F. Exterior Finish: Paint.

G. Interior Finish: Paint.

H. Hardware: RE: Section 06 41 93 Interior Hardware Schedule.

2.3 COUNTERTOP SUPPORT:

A. Dimensional Lumber
   1. 2X4 framing at 6” mitered edge countertop perimeter and between lavatories.
   2. 1 X 3 framing at 4” mitered edge countertop, at wall sides only.

B. Plywood Decking: ¾” thick.

C. 2”X2” STEEL TUBE LEG: 2”X2”
2.3 CASEWORK HARDWARE: Provide cabinet hardware and accessory materials associated with architectural cabinets and countertops.
   A. RE: Section 06 41 93 Interior Hardware Schedule.
   B. Hardware Standard: Comply with BHMAA156.9 for items indicated by reference to BHMA numbers or referenced to this standard.

2.4 COUNTERTOPS AND SPLASHES:
   A. Quartz-based fabricated solid surface (CT-1 & S-1)
      1. Wilsonart Quartz.
      2. Upper Wolfjaw (Q4038)
      3. Edge Detail: Mitered with matched veining on all surfaces. RE: Interior Elevations for edge dimensions

2.5 MISCELLANEOUS MATERIALS
   A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
   B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
   C. Adhesives: Do not use adhesives that contain urea formaldehyde.
   D. Sealants: Refer to Section 07 92 00 Joint Sealants.

PART 3 EXECUTION

3.1 PREPARATION
   A. Verify size of all plumbing fixtures before beginning casework.

3.2 INSTALLATION
   A. Install casework plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches.
   B. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
   C. Countertops: Anchor securely to base units. Seal space between backsplash and wall.
3.3 QUARTZ FABRICATION AND INSTALLATION

A. Fabricate quartz countertops to comply with recommendations of Marble Institute of America’s Dimensional Stone – Design Manual IV.

B. Fabricate countertops without seams.

C. Finish all exposed faces and edges of quartz.

D. Install countertops over plywood substrate with full spread of water-cleanable epoxy adhesive.

E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts while cutting.

F. Do not field cut quartz unless otherwise indicated.

G. Shim pieces as required to produce surfaces that are plumb, level, flush, aligned, and true.

H. Apply adhesives only after adjustments and corrections to fit have been made.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets to eliminate functional and visual defects. Replace casework where impossible to repair.

B. Clean, lubricate, and adjust hardware to achieve uniform and level cabinet front spacing.

END OF SECTION 06 40 00
### SECTION 06 41 93 – INTERIOR HARDWARE SCHEDULE

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MANUF</th>
<th>MODEL #</th>
<th>SIZE</th>
<th>FINISH</th>
<th>REMARKS/QUESTIONS</th>
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<tr>
<td>HANDRAIL SUPPORT</td>
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<td>ADJUSTABLE SHELF SUPPORTS</td>
<td>HAFELE</td>
<td>#282.01.701 SHELF SUPPORTS</td>
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<td>MINIMUM OF 4 SUPPORTS PER SHELF. PROVIDE ALL HARDWARE NECESSARY FOR INSTALLATION</td>
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<td>WITH #282.50.704</td>
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<td>DRAWER GLIDES</td>
<td>ACCURIDE,</td>
<td>SELF CLOSING</td>
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<td></td>
<td>FULL EXTENSION GLIDES APPROPRIATE FOR SIZE AND WEIGHT OF DRAWER AND CONTENTS.</td>
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<td>GRANT K&amp;V OR EQUAL</td>
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<td>PROVIDE ALL HARDWARE NECESSARY FOR INSTALLATION.</td>
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<td>CONCEALED CABINET HINGES</td>
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<td>EUROPEAN STYLE 3-D Hinge, Self-Closing 120 Degree Opening or as Required by Location.</td>
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<td>Screw-Mounted Nickel-Plated Steel with Automatic Springs. Provide All Accessories Necessary for Installation. Verify Locations for 90 Degree Openings with TPWD Construction Manager.</td>
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<tr>
<td>CABINET DRAWER PULLS AND KNOBS</td>
<td>T.B.D.</td>
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DIVISION 7  THERMAL AND MOISTURE PROTECTION

SECTION 07 21 00 – BUILDING INSULATION

PART 1 – GENERAL

1.1  Scope: The work of this Section includes concealed building insulation.

1.2  SUBMITTALS

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

1.3  QUALITY ASSURANCE

A.  Identify materials with appropriate markings of applicable testing and inspecting agency; indicate the following characteristics:


1.4  DELIVERY, STORAGE, AND HANDLING

A.  Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources.

B.  Comply with manufacturer’s written instructions for handling, storing, and protecting during installation.

PART 2 – PRODUCTS

2.1  FIBERGLASS BLANKET INSULATION

A.  Owens Corning EcoTouch PINK Fiberglass Insulation, unfaced, or equal, to comply with the following applications:

1.  Roofs: R-38, minimum.
2.  Exterior Walls: 3 ½” thickness, minimum.
3.  Floors over unconditioned space: R-30, minimum.

2.2  BLOWN INSULATION

A.  Owens Corning PROPINK L77 PINK , or equal

B  Application: Floor/ Ceiling Assembly Fill Material
2.3 SOUND ATTENUATION BATT INSULATION

A. Unfaced roll type, 3 1/2” thick.

B. Application: Interior walls as indicated on Drawings

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected.

B. Review placement area to determine final location will not be within 3 inches of any heat source where the temperature will exceed 200 deg F per ASTM C 411 or in accordance with authorities having jurisdiction. Insulation labeled as “insulation contact” (IC) rated may be installed adjacent to recessed light fixtures.

3.2 PREPARATION

A. Clean substrates and cavities of loose materials capable of interfering with insulation placement.

3.3 APPLICATION

A. Apply insulation to substrates in compliance with manufacturer’s written instructions.


C. Extend insulation in thickness indicated to envelop entire area to be insulated. Support insulation as recommended by manufacturer.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse.

END OF SECTION 07 21 00
SECTION 07 31 13 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Asphalt roofing shingles including ridge cap shingles.
   2. Leak barrier and roof deck protection.
   3. Metal flashing associated with shingle roofing.
   4. Attic and soffit ventilation.

1.2 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's “The NRCA Roofing and Waterproofing Manual” for definitions of roofing terms related to roofing work in this Section.

1.3 SUBMITTALS

A. Product Data: Submit copies of manufacturer’s product data sheets, and detail drawings for each type of roofing product.

B. Samples for Initial Selection: For each exposed product and for each color and blend specified.

C. Warrantees: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all primary roofing products, including shingles, underlayment, leak barrier, and ventilation, by a single manufacturer.

B. Installer Qualifications: Installer must be approved for installation of all roofing products to be installed under this Section.

C. Pre-installation Conference: Conduct conference at Project site under provisions of Division 01.

1.5 REGULATORY REQUIREMENTS

A. Provide a roofing system achieving an Underwriters Laboratories (UL) Class A fire classification.

B. Install all roofing products in accordance with all federal, state and local building codes.

C. All work shall be performed in a manner consistent with current OSHA guidelines.

1.6 PREINSTALLATION MEETING
A. General: For all projects in excess of 250 squares of roofing, a pre-installation meeting is strongly recommended.

B. Timing: The meeting shall take place at the start of the roofing installation, in accordance with Division 01, but no more than two (2) weeks into the roofing project.

C. Attendees: Meeting to be called for by manufacturer’s certified contractor. Meeting’s mandatory attendees shall include the certified contractor and the manufacturer’s representative. Non-mandatory attendees shall include the TPWD Construction Manager, Architect or Engineer’s representative, and the General Contractor’s representative.

D. Topics: Certified contractor and manufacturer’s representative shall review all pertinent requirements for the Project, including but not limited to, scheduling, weather considerations, project duration, and requirements for the specified warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store all products in manufacturer’s unopened, labeled packaging until they are ready for installation.

B. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls. Store at temperature not more than 110 degrees F (43 degrees C).

C. Store bundles on a flat surface. Maximum stacking height shall not exceed manufacturer’s recommendations. Store all rolls on end.

D. Store and dispose of solvent-based materials in accordance with all federal, state and local regulations.

E. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.8 PROJECT CONDITIONS

1. Proceed with work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer’s recommendations.

1.9 WARRANTY

A. Provide to the Owner a GAF 30 year standard manufacturer’s warranty for 30 year ELK timberline.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURER

A. Specifications are based on products manufactured by GAF Materials Corporation, Wayne, NJ; (973) 628-3000, or Architect approved equal. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with
Section 01 25 00 “Substitution Procedures” for requirements regarding substitutions to be considered.

2.2 SHINGLES

A. Self-sealing, granule surfaced, asphalt shingle with a strong fiberglass reinforced Micro Weave® core and StainGuard® protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules. Architectural laminate styling provides a wood shake appearance with a 5 inch exposure and features the classic Natural Shadow™ effect. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM C 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462, Texas Dept of Insurance Approved, ICC Report Approval, Timberline® Natural Shadow™ Lifetime Shingles, by GAF.

1. Color:
2. Reflectance:

2.3 RIDGE CAP SHINGLES

A. Fiberglass asphalt design UL 790 Class A fire rated self-sealing ridge cap shingles complying with ASTM D3018, ASTM D3161, and ASTM D3462 of approximately 10 inches in width and having a 5 5/8” exposure. Seal-A-Ridge Ridge Cap Shingles (Fontana).

2.4 STARTER STRIP

A. Self-sealing starter shingle designed for premium roof shingles. Each bundle covers approximately 100 lineal feet (30.48m) or 50 lineal feet (15.24m) for oversized shingles. WeatherBlocker Eave/Rake Starter Strip.

2.5 LEAK BARRIER

A. Self-adhering, self-sealing, bituminous leak barrier surfaced with fine, skid-resistant granules. Approved by UL, ICC, and Texas Department of Insurance. Each roll contains approx. 150 sq.ft.(13.9 sq.m.), 36 inches x 50 feet (0.9m x 15.24m) or 200 sq. ft. (18.6 sq.m.), 36 inches x 66.7 feet (0.9mx20.3m). WeatherWatch® Leak Barrier.

2.6 SHINGLE UNDERLAYMENT MATERIALS

A. #30 Roofing Underlayment – by Others: Water repellent breather type cellulose fiber building paper. Meets or exceeds the requirements of ASTM D-4869 Type II.

2.7 ROOFING CEMENT

A. Asphalt Plastic Roofing Cement meeting the requirements of ASTM D 4869 Type I or II

2.8 ROOFING ACCESSORIES
A. Exterior acrylic rust resistant aerosol roof accessory paint. Each 6 oz. can is available in boxes of 6 and in a wide variety of colors to compliment the roof. Shingle-Match™ Roof Accessory Paint.

2.9 ATTIC AND SOFFIT VENTILATION

A. Ridge Vents:
1. Rigid plastic ridge ventilator designed to allow the passage of hot air out of attics. For use in conjunction with eave/soffit intake ventilation products. Provides 18.0 sq. inches (11613 sq.mm/m) in NFVA per lineal foot. Each package contains 40 lineal feet (12.19m) of vent. Cobra® Rigid Vent 2 ridge vent (includes 3 inch (76mm) galvanized ring shank nails).

2.10 NAILS

A. Standard round wire, zinc-coated steel or aluminum; 10 to 12 gauge, smooth, barbed or deformed shank, with heads 3/8 inch (9mm) to 7/16 inch (11mm) in diameter. Length must be sufficient to penetrate into solid wood at least ¾ inch (19mm) or through plywood or oriented strand board by at least 1/8 inch (3.18mm).

2.11 METAL FLASHING AND TRIM

A. 24 gauge hot-dip galvanized steel sheet, complying with ASTM A 653/A 653M, G90/Z275

2.12 OTHER MATERIALS

A. Provide other materials, not specifically described, but required for a complete and proper installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the roof deck has been properly prepared.

B. If roof deck preparation is the responsibility of another installer, notify the TPWD Construction Manager of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean deck surfaces thoroughly prior to installation of eaves protection membrane and underlayment.

B. At areas that receive eaves protection membrane, fill knotholes and cracks with latex filler.

C. Install crickets on the upslope side of all chimneys in the north, any chimney wider than 24 inches (610mm), and on all roofs steeper than 6/12.
3.3 UNDERLAYMENT INSTALLATION

A. General: Install using methods recommended by manufacturer, in accordance with local building codes. When local codes and application instructions are in conflict, the more stringent requirements shall take precedence.

B. Eaves:
   1. Install eaves edge metal flashing tight with fascia boards; lap joints 2 inches (51mm) and seal with plastic cement or high quality urethane sealant; nail at the top of the flange.
   2. In the north, and on all roofs between 2 ½ and 4/12 (low slopes) install GAF leak barrier up the slope from eaves edge of full 36 inches (914mm) or to at least 24 inches (610 mm) beyond the interior “warm wall”. Lap ends 6 inches (152mm) and bond.

C. Valleys:
   1. Install eaves protection membrane at least 36 (914mm) inches wide and centered on the valley. Lap ends 6 inches (152mm) and seal.
   2. All valleys to have 1 ply “weather watch” GAF product per manufacturer’s instructions; DO NOT nail through the flashing. Secure the flashing by nailing at 18 inches (457 mm) on center just beyond edge of flashing so that nail heads hold down the edge.

D. Hips and Ridges: Install GAF leak barrier along entire lengths. If ridge vents are to be installed, position the GAF leak barrier so that the ridge slots will not be covered.

E. Roof Deck:
   1. Install one layer of GAF roof deck protection over the entire area no protected by GAF leak barrier at the eaves or valley. Install sheets horizontally so water sheds and nail in place.
   2. On roofs sloped at more than 4 in 12, lap horizontal edges at least 2 inches (51mm) and at least 2 inches (51mm) over eaves protection membrane.
   3. On roofs sloped between 2 in 12 and 4 in 12, lap horizontal edges at least 19 inches (482 mm) and at least 19 inches (482mm) over eaves protection membrane.
   4. Lap ends at least 4 inches (102mm). Stagger end laps of each layer at least 36 inches (914 mm).
   5. Lap GAF roof deck protection over GAF leak barrier in valley at least 6 inches (152 mm).

3.4 INSTALLATION OF SHINGLES

A. General:
   1. Install shingles and ridge cap shingles in accordance with GAF’s instructions and local building codes. When local codes and application instructions are in conflict, the more stringent requirements shall take precedence.
   2. Minimize breakage of shingles by avoiding dropping bundles on edge, by separating shingles carefully (not by “breaking” over ridge or bundles), and by taking extra precautions in temperatures below 40 degrees F (4 degrees C).
      a. There shall be no chips or cracks whatsoever and the edges shall extend from the edge between ½ inch and ¼ inch, or manufacturer’s specifications.
   3. Handle carefully in hot weather to avoid scuffing the surfacing, or damaging the shingle edges.
   4. Installed roof shingles shall lay completely flat without buckling. Shingles shall not ripple, bow, bend or flip-up at the edges.
   5. Along the sides of the roof, the shingles shall be cut evenly and within the manufacturer’s specifications for overhang.
   6. Where the sides of shingles meet the face of another structure, there shall be appropriate flashing and no bowing.
B. Placement and Nailing
   1. For maximum wind resistance along rakes & eaves, install any GAF starter strip containing sealant or cement shingles to underlayment and each other in a 4" (102mm) width of asphalt plastic roof cement.
   2. Secure with 4, 5, or 6 nails per shingle per GAF's instructions or local codes.
   3. Placement of nails varies based on the type of shingle specified. Consult the application instructions for the specified shingle for details.
   4. Nails must be driven flush with the shingle surface. Do not overdrive or under drive the nails.
   5. Shingle offset varies based on the type of shingle specified. Consult the application instructions for the specified shingle for details.

C. Valleys:
   1. Install valleys using the “open valley” method:
      a. Snap diverging chalk lines on the metal flashing, start at 3 inches (76mm) each side of top of valley, spreading at 1/8 inch per foot (9mm per meter) to the eaves.
      b. Run shingles to chalk line.
      c. Trim last shingle in each course to match the chalk line; do not trim shingles to less than 12 inches (305mm) wide.
      d. Apply a 2 inch (51mm) wide strip of plastic cement under ends of shingles, sealing them to the metal flashing.

D. Penetrations: All Penetrations are to be flashed according to GAF, ARMA and NRCA application instructions and construction details.

3.5 INSTALLATION OF ATTIC VENTILATION

A. General: Ventilation must meet or exceed current FHA, HUD and local code requirements.

B. Ridge/Soffit ventilation
   1. Install ridge vent along the entire length of ridges:
   2. Cut continuous vent slots through the sheathing, stopping 6” (152mm) from each end of the ridge.
   3. On roofs without ridge board, make a slot 1 inch (25mm) wide, on either side of the peak (2 inches (51mm) overall).
   4. On roofs with ridge board, make two slots 1 ¾ inches (44.5mm) wide, one on each side of the peak (3 ½ inches (89mm) overall).
   5. Install ridge vent material along the full length of he ridge, including uncut areas.
   6. Butt ends of ridge vent material and join using roofing cement.
   7. Install eaves vents in sufficient quantity to equal or exceed the ridge vent area.

3.6 PROTECTION

A. Protect installed products from foot traffic until completion of the project.

B. All roof areas that are not completed by the end of the workday are to be protected from moisture and contaminants.

END OF SECTION 07 31 13
SECTION 07 46 00 – FIBER CEMENT SIDING

PART 1 – GENERAL

1.1 SCOPE

A. The Work of this Section includes:
   1. Fiber cement siding.
   2. Fiber cement panel.
   3. Fiber cement trim.
   5. Perforated Corrugated Fiber cement panels.

1.2 SUBMITTALS

A. Product Data: For each product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of siding, and panel, and related accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

B. Source Limitations: Obtain all types of siding, panel, and trim from single manufacturer.

1.5 COORDINATION

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.6 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding and soffit that fail in materials or workmanship within specified warranty period.
   1. Failures to include, but not be limited to structural failures including cracking, deforming.
   2. Warranty Period: Contractor to follow instructions to validate the warranty
      a. Hardie Plank Lap Siding for 30 years
      b. Hardie-Panel
      c. Hardie Soffit for 30 years
      d. Hardie-Trim for 15 years
PART 2 - PRODUCT

2.1 GENERAL

A. Fire Standards: ASTM C 1186, Type A, Grade II, fiber cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

B. Manufacturer: Subject to compliance with requirements, provide James Hardie products.

C. Factory Priming: Provide manufacturer’s standard acrylic primer for all fiber cement products.

D. Field Finishing: RE: Section 09 90 00

2.2 VERTICAL SIDING: RE: Drawings for locations.

A. Hardie Plank Lap Siding:
   1. Texture: smooth
   2. Sizes:
      a. 5/16" x 7 ¼" (6" Exposure)

B. Hardie-Panel:
   1. Texture: smooth
   2. Sizes:
      a. 5/16" x 4' x 8'

2.3 TRIM

A. Hardie Trim: RE: Drawings for locations.
   1. Texture: smooth
      a. ¾" X 7 ¼".
      b. ¾" X 5 ½".
      c. ¾" X 3 ½".

2.4 CORRUGATED PANELS

A. Marley Eternit Profiled sheeting. Refer to section 2.6.D for accessories.
   1. Profile 6: 5 ¾” corrugations, sheet sizes: 42 ¾" wide x 4'-0" to 10'-0" lengths in 6" increments. Install with 3" side overlaps, 6 ½" end overlaps
   2. Corrugated and perforated sheeting: Profile 6: 5 ¾” corrugations, sheet sizes: 42 ¾" wide x 4'-0" to 10'-0" lengths in 6" increments. Install with 3" side overlaps, 6 ½" end overlaps. RE: Sheet A.521, detail 05 for spacing of perforations. 1" holes on 2" centers, staggered. Holes to be on ridges and valleys of each panel.
2.5 ACCESSORIES

A. Flashing: Provide aluminum flashing complying with Section 07 62 00 Sheet Metal Flashing and Trim at window and door heads and where indicated.

B. Fasteners:
   1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
   2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
   3. Use hot-dip galvanized fasteners.

C. Rainscreen Screed: 3/8” thick material as required to meet fiber cement manufacturer's warranty requirements. Contractor to select from following or similar products for TPWD Construction Manager’s approval:

D. Edge detailing for Corrugated Fiber Cement panels from standard Marley Eternit accessories:
   1. Corner Piece, 7 7/8” x 7 7/8” at corners
   2. Jamb Filler, at doors windows and openings.
   3. Top fix fasteners,
   4. Z flashing for window and door head, jamb and sill detailing as noted in detail sheets.

E. Soffit material at exterior porches and eaves.
   1. 1x6 poplar, number 2AC or better, Tongue and Groove, stained. Stain color: Bluestone by Cabot Stains.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and soffit and related accessories.
   1. Install water-resistive barriers and cladding to dry surfaces.
   2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
   3. Protect siding from other trades.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with siding and soffit manufacturer’s written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
   1. Do not install damaged components.
   2. Use full-length horizontal siding and trim boards wherever possible. Butt joint siding to vertical trim. Stagger butt joints in the middle of siding areas.
   3. Trim at panels is designed so no panel is greater than a 4’ x 8’ panel. All butt joints between panels to occur behind vertical and horizontal trim.

B. Install fiber cement siding, soffit, and related accessories:
   1. Place fasteners no closer than 3/8” from panel edges and 2” from panel corners.
   2. Allow minimum vertical clearances between the edge of siding and any other material in strict accordance with the manufacturer’s installation instructions.
3. Maintain clearances between siding and adjacent finished grade.
4. Specific framing and fastener requirements, refer to Tables 2 and 3 in National Evaluation Service Report No. NER-405.C. Install joint sealants as specified in Section 07 92 00 Joint Sealants and to produce a weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 00
SECTION 07 61 00 – STANDING SEAM ROOFING - ALTERNATE 5

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submit Product Data, Shop Drawings, and color Samples.
C. Provide roof assemblies that meet requirements of DESIGN WIND LOAD on S0.00.
D. Submit a written warranty, executed by manufacturer, agreeing to repair or replace sheet metal roofing that fails to remain weather tight within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. 6" hand crimped standing seam metal roofing system by Berridge:
   2. Color: T.B.D.
   3. Provide all components required for a complete roof assembly including trim, copings, clips, flashings, sealants, fillers, closure strips, as recommended by manufacturer.

2.2 ACCESSORIES

A. Roofing Underlayment: Self-adhering, polymer-modified, bituminous sheet ASTM D 1970, minimum of 40 mils (1 mm) thick, Minimum 5 lb/100 sq. ft. (2.4 kg/sq. m), rosin-sized building paper or asphalt-saturated organic felts ASTM D 226, Type II (No. 30).
B. Vapor Retarder: Unperforated polyolefin material complying with ASTM 1677, Type I, with minimum or maximum water-vapor transmission of 10 perms. (Tyvek or equal).
C. Metal Accessories: Matching sheet metal roofing in finish and material required for a complete weathertight roofing system, including clips, flashings, ridge closure strips, trim, copings, gutters, and downspouts.
2.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Remove strippable protective covering on metal panels as panels are being installed. Do not leave the film on installed panels.

2.4 FABRICATION

A. Fabricate sheet metal roofing and wall panels to comply with recommendations of SMACNA’s “Architectural Sheet Metal Manual” that apply to the design, dimensions, metal, and other characteristics of installation indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install according to manufacturer’s recommendations.

B. Anchor panels securely in place, with provisions for thermal and structural movement. Install panels with concealed fasteners.

C. Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of wall panel assemblies. Provide types of gaskets, fillers, and sealants as indicated, or as recommended by panel manufacturer.

D. Separate dissimilar metals and metal panels from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

E. Anchor roofing securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.

F. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant. Fold back sheet metal to form a hem on concealed side of exposed edges, unless otherwise indicated.

END OF SECTION 07610
SECTION 07 62 00 – SHEET METAL FLASHING, GUTTERS AND TRIM

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes:
   1. Fabricated flashing with counterflashing.
   2. Aluminum Gutters, if Alternate 5 is selected, match material of the roof.
   3. Aluminum Downspouts, if Alternate 5 is selected, match material of the roof.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak-proof, secure, and noncorrosive installation.

1.3 SUBmittALS

A. Product Data: For each type of product.

B. Shop Drawings: For each profile required.

C. Samples: For each finish specified.

1.4 QUALITY ASSURANCE

A. Reference Standard: Comply with SMACNA’s “Architectural Sheet Metal Manual unless more stringent requirements are specified or shown on Drawings.

B. Pre-installation Conference: Include the following agenda items as part of roofing conference:
   1. Review Construction Schedule. Verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and other conditions of construction that affect sheet metal flashing and trim.
   3. Review requirements for warranty and certificates if applicable.
   4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

C. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.
1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturers standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA’s "The NRCA Roofing Manual" and SMACNA’s "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals’ "RoofNav" and approved for windstorm classification, Vultmate = 150mph (3 second gust), Vasd = 116mph. Identify materials with name of fabricator and design approved by FM Approvals.

D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
   1. Design Pressure: As indicated on Structural Drawings.

2.2 SHEET METAL

A. Aluminum-Zinc Alloy-Coated Steel Sheet: Provide according to ASTM A 792/A 792M, 24-Gauge, Class AZ-50 coating, Grade 40; pre-painted by coil-coating process to comply with ASTM A 755/A 755M
   1. Surface: Smooth, flat and with manufacturer’s standard clear acrylic coating on both sides.
   2. Exposed Coil-Coated Finish: Color T.B.D. from manufacturer’s standard colors.

B. Aluminum Sheet: ASTM B209, alloy as standard per manufacturer for finish required, with temper to suit forming operations and performance required.
   1. Surface: Smooth, flat finish.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
      b. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape ½" wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

G. Gutters: Formed from aluminum, or if Alternate 5 is selected, same as roof complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches on center., fabricated from same metal as gutters.

H. Downspouts: Formed from same material as gutters. Fabricate in 10-foot long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

2.4 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams.

B. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
   1. Material: Aluminum-Zinc Alloy-Coated Steel Sheet, 24 gauge.

C. Copings: Fabricate continuous copings at indicated parapet caps in minimum 96-inch-long sections. Lap sections 4" minimum.
2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

D. Sealant Joints: Where movable, non-expansion type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

PART 3 – EXECUTION

3.3 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   2. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches, staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.

5. Torch cutting of sheet metal flashing and trim is not permitted.
B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
   1. Coat concealed side of sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
   1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 Joint Sealants.

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

H. Hanging Gutters: Install gutter with expansion joints per manufacturer’s recommendations. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer’s written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
   1. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

E. Counterflushing: Coordinate installation of counterflushing with installation of base flashing. Insert counterflushing in reglets or receivers and fit tightly to base flashing. Extend counterflushing 4 inches over base flashing. Lap counterflushing joints minimum of 4 inches and bed with sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.
C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00
SECTION 07 65 00 – FLEXIBLE FLASHING

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes flexible flashings where indicated on Drawings or required to divert moisture to exterior.

1.2 SUBMITTALS

A. Product Data: Include manufacturer’s written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of flashing.

B. Samples: Actual pieces of flashings specified, 6 inches x 6 inches square of flashing sheet.

1.3 QUALITY ASSURANCE

A. This Section outlines the minimum standards and requirements for this Project. Refer to the Drawings for additional requirements. Bring all conflicts and discrepancies to the attention of the TPWD Construction Manager and do not start work until such conflicts and discrepancies are clarified and corrected.

B. Installer Qualifications: Company with at least five (5) years of successful experience in weathertight installation of flashing.

C. Coordination: Interface flashing work with adjacent and adjoining work to ensure best possible weather resistance and durability of completed flashing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer’s sealed packaging, bearing manufacturer’s name and product identification.

B. Stack flashing materials to avoid twisting, bending, and abrasion. Protect materials from weather before installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on Sando-Seal Self-Adhering Flashing manufactured by Sandell Manufacturing Company, Inc. The TPWD Construction Manager may approve an equal product by one (1) of the following manufacturers via Substitution:

1. Advanced Building Products, Inc.
2. Henry Company
3. Protecto Wrap Company
4. Tamko Waterproofing
5. W. R. Grace & Co.
2.2 MATERIALS

A. Sando-Seal Self-Adhering Flashing: 40 mil thick membrane comprised of 32 mils of highly adhesive rubberized asphalt integrally bonded to an 8mil high density, cross laminated polyethylene film.

2.3 ACCESSORIES

A. Primer: Manufacturer's special primer formulated to prepare surfaces for self-adhering flashing.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that surfaces to receive flashing are thoroughly dry, free from loose materials, and reasonably smooth, with no sharp edges or projections.

B. Verify that locations to receive flashing are sloped so water that enters will drain to building exterior.

3.2 PREPARATION

A. Prime all surfaces to receive self-adhering flashing, and allow to dry for not less than 20 minutes prior to flashing application.

3.3 INSTALLATION

A. Protect membrane from overexposure to direct sunlight.

B. Install membrane at material transitions inside roof edge/exterior wall transitions, 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.

C. Heads, Jambs, 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. Head flashing shall be carried six (6) inches beyond both ends of header shingle per manufacturer’s instructions. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weep-holes.

D. 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.

E. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.

F. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.

END OF SECTION 07 65 00
SECTION 07 92 00 – JOINT SEALANTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Latex joint sealants.
   3. Preformed joint sealants.

1.2 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.
B. Sample: For each joint-sealant product indicated.

1.3 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.4 WARRANTY

A. Special Installer’s Warranty: Manufacturer’s standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.
B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by TPWD Construction Manager from manufacturer’s full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Non-sag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 795.
      b. GE Advanced Materials - Silicones; SilPruf SCS2000.
      c. Pecora Corporation; 895.
   2. Type: Single component (S) moisture-curing formation with low modulus, high elongation characteristics, capable of obtaining strong, durable bond strength to substrates.
   3. Grade: NS, non-sag.

2.3 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Products: Subject to compliance with requirements, provide one of the following:
      c. Pecora Corporation; AC-20+.
      d. Schnee-Morehead, Inc.; SM 8200.
      e. Tremco Incorporated; TremFlex 834.
   2. Type: Single component (S) moisture-curing formulation with low modulus, high elongation characteristics, capable of obtaining strong, durable bond strength to substrates.
2.4 PREFORMED JOINT SEALANTS

A. Preformed Foam Joint Sealant: Manufacturer’s standard preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
   1. Products: Subject to compliance with requirements, provide one of the following or equal:
      a. Dayton Superior Specialty Chemicals; Polytite Standard.
      d. Schul International, Inc.; Sealite, Sealite 50N.
      e. Willseal USA, LLC; Willseal 150, Willseal 250.

2.5 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer’s written instructions and the following requirements:
   1. Remove laitance and form-release agents from concrete.
   2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer’s written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
   1. Joint Locations:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Tile control and expansion joints.
      c. Joints between different materials listed above.
   2. Silicone Joint Sealant: single component, non-sag, neutral curing, class 50.
   4. Joint-Sealant Color: As selected by TPWD Construction Manager from manufacturer's full range of colors.

   1. Joint Locations:
      a. Joints between different materials listed above.
      b. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
      c. Control and expansion joints in ceilings and other overhead surfaces.
   4. Joint-Sealant Color: As selected by TPWD Construction Manager from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
   1. Joint Locations:
      b. Control and expansion joints in tile flooring.
   2. Silicone Joint Sealant: single component, non-sag, neutral curing, class 50.
   4. Joint-Sealant Color: As selected by TPWD Construction Manager from manufacturer's full range of colors.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
   3. Joint-Sealant Color: As selected by TPWD Construction Manager from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints where indicated.
   2. Joint-Sealant Color: As selected by TPWD Construction Manager from manufacturer's full range of colors.

END OF SECTION 07 92 00
DIVISION 8 DOORS AND WINDOWS

SECTION 08 13 00 – METAL DOORS

PART I – GENERAL

1.1 SCOPE: The work of this Section includes steel doors and frames.

1.2 REFERENCE STANDARDS

A. American National Standards Institutes (ANSI)
   2. A250.11 – Recommended Erection Instructions for Steel Frames.

B. ASMT International (ASTM):


D. Underwriters Laboratories (UL):
   1. 10B - Standard for Fire Tests of Door Assemblies.
   2. 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

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

B. Shop Drawings: Show locations, elevations, dimensions, model designations, fire, thermal, and acoustical ratings, preparation for hardware, and anchoring details.

C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 QUALITY ASSURANCE

A. Doors and Frames
   1. ANSI A250.8.
   2. Tolerances: SDI 117.

B. Fire Door and Frame Construction: Conform to ASTM E152, NFPA 252, and UL 10 B,

C. Installed Fire Rated Door and Frame Assemblies: Conform to NFPA 80.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ship exterior door frames with welded corners.
B. Store doors and frames upright in protected, dry area, off ground or floor, with at least 1/4 inch space between individual units.

C. Do not cover with non vented coverings that create excessive humidity.

D. Remove wet coverings immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Approved equals are acceptable.
   1. Amweld Building Products LLC. (www.amweld.com)
   2. Ceco Door Products. (www.cecodoor.com)
   3. Curries Company. (www.curries.com)
   5. Door Pro Systems, Inc.
   6. Pearland Industries, Inc.
   7. P-W Metal Products Co.
   8. Kewanee Corp. (www.kewanecorp.com)
  10. Steelcraft. (www.steelcraft.com)
  11. Masonite International Corporation

2.2 MATERIALS

A. Galvawelded Steel Sheet: ASTM A653/A653M, hot dipped, Commercial Steel (CS), Type B; with minimum A40 (ZF120)metallic coating.

B. Door Core:
   1. Foamed-in-place polyurethane insulation, rigid polystyrene insulation, or fiberglass batt insulation.

C. Frame Anchors: steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.2.3

STANDARD STEEL DOORS

A. Design: Full Flush
   1. Core Construction: Manufacturer’s Standard.
      a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
      b. Thermal Rating: R-value of not less than 6.0 deg F x h x sq.ft./Btu (1.057K x sq.m/W) when tested according to ASTM C 363.
   2. Grade: 2 – Heavy Duty
   3. Application: Weather Exposure
   4. Boring: Double, verify
   5. Thickness: 1 ¾”
B. Design: Narrow Light
   1. Core Construction: Manufacturer’s Standard.
      a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
      b. Thermal Rating: R-value of not less than 6.0 deg F x h x sq.ft./Btu (1.057K x sq.m/W) when tested according to ASTM C 363.
   2. Grade: 2 – Heavy Duty
   3. Application: Weather Exposure
   4. Boring: Double, verify
   5. Thickness: 1 ¾”

2.4 STEEL FRAMES

   1. Back bend return.
   3. Face width: 2”
   4. Throat Opening: as required.

B. Design: Flush, Double Opening.
   1. Back bend return.
   3. Face width: 2”
   4. Throat Opening: as required.

2.5 ACCESSORIES

A. Glass, Glazing Sealers, and Accessories: Specified in Section 08 80 00.

B. Primer: Zinc rich type.

2.6 FABRICATION

3.3.1.1.1 Fabricate doors and frames in accordance with ANSI A250.8, and ANSI A250.11 respectively.

B. Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level.

   1. Fabricate from minimum 18 gauge sheets.
   2. Close top and bottom edges of doors with steel channel, minimum 16 gauge, extending full width of door, and spot welded to both faces, with top channel flush and bottom channel recessed. 14 gauge steel channel 20” long as closer reinforcement
   3. Fill voids between vertical steel stiffeners with insulation.

D. Frames:
   1. Fabricate from minimum 16 gauge sheets.
   2. Provide set up and welded corners.
   3. Anchors:
      a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
      b. Provide one anchor at each jamb for each 30 inches of door height.
c. Design anchors to provide positive fastenings to adjacent construction.
d. Provide one floor anchor welded to each jamb.

4. Terminate stops 6 inches above finished floor. Cut bottom edge of stop at 45 degree angle and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

E. Accurately form to required sizes and profiles.

F. Grind and dress exposed welds to form smooth, flush surfaces.

G. Do not use metallic filler to conceal manufacturing defects.

H. Fabricate with internal reinforcement for hardware specified in Section 08 71 00; weld in place.

I. Glazing Stops:
   1. Manufacturer's standard, screw on type with mitered corners.
   2. Form stops from minimum 20 gage steel; prefir for field glazing.
   3. Locate screws within 1 inch of ends of stops and maximum 8 inches on center.
   4. Install glazing stops on secure side of frames.

2.7 FINISHES

A. Dress tool marks and surface imperfections to smooth surfaces.

B. Chemically treat and clean.

C. Touch up damaged metallic coatings.

D. Apply manufacturer's standard primer paint, ANSI/SDI A250.10


PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Metal Frames: Comply with ANSI A250.11.
   1. Remove shipping bars prior to installation.
   2. Set frames accurately in position plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames according to NFPA 80
      b. Install frames with removable glazing stops located on secure side of opening.
      c. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installation expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

5. Installation Tolerances: Adjust frames for squareness, alignment, twisting and plumbness to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at floor.

B. Steel Doors: Fit doors accurately in frames, within clearances specified below. Shim as necessary.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
      b. Between Edges of Pair of Doors: 1/8 inch plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
      d. Between Bottom of Door and Top of Finished Floor (No Threshold): Maximum ¾ inch.

   2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

   3. Smoke-Control Doors: Install doors according to NFPA 105

C. Secure to adjacent construction using fastener type best suited to application.

D. Install glass as specified in Section 08 80 00.
   1. Secure stops with countersunk flat or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

E. Install hardware in accordance with Section 08 71 00.

3.2 ADJUSTING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including steel work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touch-up: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer’s written instructions.

END OF SECTION 08 13 00
SECTION 08 14 00 – WOOD DOORS

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes:
   1. Solid-core wood doors.
   2. Stile and rail MDF doors.
   3. Factory finishing.
   4. Factory fitting to frames and factory machining for hardware.

1.2 REFERENCE STANDARDS

A. Architectural Woodwork Institute (AWI) - Architectural Woodwork Quality Standards.


C. Underwriters Laboratories (UL):
   1. 10B - Standard for Fire Tests of Door Assemblies.
   2. 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

D. Window and Door Manufacturers Association (WDMA) - 1.S.1A - Industry Standard for Architectural Flush Wood Doors.

1.3 SUBMITTALS

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

B. Shop Drawings: Show locations, elevations, dimensions fire ratings, and preparation for hardware.

C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 QUALITY ASSURANCE


B. Fire Door Construction: Conform to UL 10C.

C. Installed Fire Rated Door Assembly: Conform to NFPA 80.

1.5 DELIVERY, STORAGE AND HANDLING

A. Package doors in heavy plastic with identifying marks; slit plastic wrap on site to permit ventilation, but do not remove from plastic until ready to install.

B. Do not deliver doors until building is substantially water and weather tight and HVAC system is operational.

C. Store doors flat and level, with spacers between doors to allow for air circulation, in protected, dry area.

D. Maintain humidity in storage areas between 25 and 55 percent.
1.6  WARRANTY

A. Furnish manufacturer’s one year warranty providing coverage against defects in materials and workmanship and warpage beyond specified amount.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Approved equals are acceptable.
   1. Krosswood (www.krosswood.com)
   2. Algoma Hardwoods, Inc. (www.algomahardwoods.com)
   3. Egers Industries. (www.eggersindustries.com)
   5. Oshkosh Door Co. (www.oshkoshdoor.com)
   6. VT Industries, Inc. (www.vtindustries.com)
   7. TruStile (www.trustile.com)

2.2 MATERIALS

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

2.3 Solid Core-Wood Doors: WDMA I.S.1.

   1. Core type:
      a. Solid, fire rated: as indicated.
      b. Solid, non rated: Manufacturer's Standard.
   2. Number of plies: 5.
   3. Performance duty level 2: Heavy Duty
   5. Thickness as scheduled.
   6. Vision Lite: as scheduled.
   8. Adhesives: Water-resistant type.

2.4 ACCESSORIES

A. Glass and Glazing Accessories: Specified in Section 08 80 00.

2.5 FABRICATION

A. Fabricate doors in accordance with WDMA I.S.1A.
   1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Prefitting: Factory fit doors to wood frames.

C. Premachining: Factory machine doors to receive hardware specified in Section 08 71 00.

D. Openings: Cut and trim openings through doors in factory.
   1. Lite Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished.

2.6 FACTORY FINISHES

A. General: Comply with referenced quality standard for factory finishing.
B.

C. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

D. Finish: Manufacturer’s Primer.

E. Field-Applied Finish: RE: Section 09 90 00 Interior Painting and Staining.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition doors to average humidity that will be encountered after installation.

3.2 INSTALLATION

A. Install doors in accordance with WDMA I.S.1A and manufacturer’s written instructions.

B. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

D. Clearances: Provide 1/8” at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide ¼ inch from bottom of door to top of threshold unless otherwise indicated.
   1. Comply with NFPA 80 for fire-rated doors.

E. Install doors plumb and level.

F. If field cutting for height is necessary, cut bottom edge only.

G. Seal field cut surfaces with same finish as door faces.

H. Install door hardware in accordance with Section 08 71 00.

I. Include the following if glazed panels. Install glass as specified in Section 08 80 00.

END OF SECTION 08 14 00
SECTION 08 45 23 – FIBERGLASS SKYLIGHTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Translucent sandwich panel systems.

1.2 RELATED REQUIREMENTS

1.3 ADMINISTRATIVE REQUIREMENTS FOR SEQUENCING

A. Ensure that locating templates and other information required for installation of wall system(s) are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.4 SUBMITTALS

A. Product Data: Manufacturer’s data sheets on each product to be used, including preparation instructions and recommendations, storage and handling requirements, installation methods and maintenance instructions.

B. Shop Drawings: Include plans, elevations, sections, and details, indicating dimensions, tolerances, profiles, anchorage, connections, fasteners, provisions for expansion and contraction, drainage, flashing, finish, glazing, and attachments to other Work.

C. Samples:
   1. Submit sample sets of color chips for initial selection representing manufacturer’s full range of available colors and finishes.

D. Test Reports: Submit certified test report data from a qualified independent testing agency, indicating wall systems comply with specified requirements. Submit results from the following:
   1. Flame spread and smoke development, ASTM E 84.
   2. Burn extent, ASTM D 635.
   3. Color change, ASTM D 2244 in accordance with ASTM D 1435.
   4. Impact strength, exterior face sheets, UL 972.
   5. Accelerated aging, ASTM D 1037.
   10. Air infiltration, ASTM E 283.
   14. Certification authorization under the NFRC PCP (Framing and Panel).
   15. ASTM E1886/E1996 for Large Missile Impact Resistance (up to Wind Zone 3, Missile Level D)
   16. Texas Department of Insurance
1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum ten years documented experience in the fabrication of wall systems of the type required for this project and capable of providing field service representation during installation.
B. Installer Qualifications: Minimum five years documented experience in the work of this section, specializing in work similar to project requirements and approved by manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, and installation location.
B. Storage/Handling: Store products above the floor and under cover in a clean, dry area until installation. Protect materials and finish from damage during handling and installation.

1.7 SITE CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTIES

A. Material Workmanship:
   1. Provide manufacturer's standard 1 year.
   2. Optional: 5 years / 10 years.
B. Exterior Fiberglass Color Change:
   1. Provide manufacturer's standard 10 years.
   2. Optional: 10 years / 20 years.
C. Fiberglass Fiberbloom: Provide manufacturer's standard 20 year warranty.
D. Metal Finishes:
   1. Anodize: Provide manufacturer's standard 5 year / optional 10 year.
   2. 50% Kynar® Paint: Provide manufacturer's standard 5 year / optional 10 year.
   3. 70% Kynar® Paint: Provide manufacturer's standard 10 year / optional 20 year.

PART 2 PRODUCTS

2.1 TRANSLUCENT PANEL SYSTEMS

A. Guardian 275® Translucent Skylight System.

2.2 DESIGN / PERFORMANCE REQUIREMENTS

A. Performance Requirements:
   1. Framing Members: Sufficient sizes as required to support design loads.
B. Deflection Limits: Shall not exceed: L/120 per IBC code requirements.
C. Safety Factors: Allowable stresses shall incorporate following safety factors, unless otherwise specified: Load Carrying Members: 1.65, Load Carrying Fasteners: 2.0.
D. Expansion and Contraction: Design and install components with provisions for expansion and contraction due to a 100 degree F (56 degrees C) temperature variation.
E. Design Loads: Framing components shall be designed to support the following loads:
   1. Live Load:
      a. As indicated on the Drawings.
   2. Wind Load:
      a. As indicated on the Drawings.
F. Windborne Debris/Impact Resistance: Provide systems that are listed by Texas Department of Insurance, and pass missile-impact and cyclic pressure tests according to ASTM E 1886 and ASTM E1996.

2.3 MANUFACTURERS
A. Acceptable Manufacturer: Major Industries Inc., 7120 Stewart Ave, Wausau, WI 54401;
   Tel: 888-759-2678 / 715-842-4616; Fax: 715-848-3336; info@majorskylights.com.
      Contact: Chuck Vojtech. chuck@rpcinc.com

2.4 COMPONENTS
A. Translucent Panel Units:
      b. U-Factor: Center of Panel U-factor (for glazing comparisons only). System must be NFRC Certified.
         1) 2-3/4 inch:
            a) 0.20 (Insul 24).
b) 0.48 (no insulation)

c. Grid Pattern:
   1) In-line Shoji (12 inch x 24 inch).

d. Unbonded Areas: Maximum of 4 unbonded areas, a maximum of 3/64 inch in diameter, in an area a maximum of 40 square feet of panel surface.

e. Panel Weeps: Weep holes provided on down slope side of installed panels to permit condensation to leave panel interior.

f. Panel Corners: Notch and interlock or reinforce with aluminum for radius conditions.

g. Assembly: Factory assembled. Field assembly of panels not allowed.

2. Physical Properties:
   a. ASTM E 108 - Burning Brand: Class A rating.
   b. ASTM E 72 and E 330 - Uniform Load Deflection.
   c. ASTM E 661 - Concentrated and Impact.
   d. ASTM E 283 - Air Infiltration through fixed panel system and perimeter framing: less than 0.01 cfm/ft air leakage at 6.24 psf air pressure.
   e. ASTM E 331 - Water penetration through fixed panel system and perimeter framing.
      No leakage when water is applied to entire panel surface at rate of 5 gal/hr/sq ft for 15 minutes at 12 psf air pressure.

3. I-Beam Grid Core:
   b. 7/16 inch (11 mm) minimum flange width, 0.050 inch (1.27 mm) web thickness.
   c. Full surface contact with face sheets.

4. Adhesive:
   a. Waterproof resin for use in laminating face sheet to aluminum grid core.
   c. Adhesive Bond Line: Straight, black, cover entire width of I-beam, with neat edge.

5. Translucent Face Sheets:
   a. Appearance of Face Sheets:
      1) Uniform in color to prevent splotchy appearance.
      2) Free of ridges, wrinkles, clusters of air bubbles and pinholes.
      3) ICC-ES listed (ER 2026).
   b. Exterior Face Sheet:
      1) ASTM D 2244: Color change shall not exceed 3.0 Delta E units after 5 years of weathering (accelerated Arizona / simulated South Florida testing).
      2) Protective Weathering Surface:
         a) Application: Factory-applied.
         b) Minimum Thickness: 1.0 mil.
         c) Repairs: Fully field repairable.
3) Impact Strength, UL 972 / Thickness (Select One):
   a) High-impact - 360 foot-pounds / 0.060 inches.
4) Color (To be selected):
   a) White.
   b) Crystal.
c) Interior Face Sheet:
   1) Flame Spread, ASTM E 84: 10 maximum.
   2) Smoke Development, ASTM E 84: 300 maximum.
   3) Burn Rate, ASTM D 635: 1.0 inch per minute maximum.
   4) Self-Ignition, ASTM D 1929: Greater than 650 degrees F.
   5) Thickness:
      a) Standard - 0.045 inches.
6) Color:
   a) White.
   b) Crystal.

B. Components and Framing:
   1. Aluminum:
      b) Formed Aluminum Components and Flashing: ASTM B 209, Alloy 5005-H34.
      c) Minimum Flashing Thickness: 0.040 inch.
   2. Interior/Exterior Glazing Gaskets:
      a) Factory installed (in extruded dovetail slots) EPDM hybrid, 9/16 inch wide.

C. Condensation Control System:
   1. Mechanically design to function properly with minimal dependency upon sealants.
   2. Provide an integral gutter system on all framing members.

D. Custom Designs: 3D modeling used to verify custom fitting and assembly.

E. Expansion and Contraction: Design and install components with provisions for expansion and contraction due to a 100 degree F temperature variation.

F. Glazing Caps:
   1. Extruded aluminum.
   2. Attach with fasteners a maximum of 12 inches on center or as required to resist negative loading.
   3. Fastener covers with finish to match system framing.

G. Fasteners:
   2. Construction and Glazing Cap Fasteners: 18-8 stainless steel - include gasketed sealing washers.
   3. Field Anchors: Cadmium plated, unless otherwise specified.

2.5 FABRICATION
A. Construct wall systems of extruded aluminum shapes similar to sections indicated on the Drawings.
B. Weep Holes Components: Located as required to control condensation and allow it to pass to the exterior.
ALUMINUM FINISHES
A. Anodized Coating: Architectural Class I clear anodized, Type AA-M10C22A41.
B. Anodized Coating: Architectural Class II clear anodized, Type AA-M10C22A31.
C. Anodized Coating: Architectural Class I pigmented anodized, Type AA-M10C22A42/A44.
   1. Color: ____________ / or <as indicated on the drawings>.
D. Pigmented Organic Coating: AAMA 2604.
   1. Color: ____________ / or <as indicated on the drawings>.
E. High-Performance Pigmented Organic Coating: AAMA 2605.
   1. Color: ____________ / or <as indicated on the drawings>.

PART 3 EXECUTION
3.1 EXAMINATION
A. Examine areas to receive translucent wall system with installer and manufacturer's representative present, including supporting structure and substrate for dimensions, tolerances, material conditions, and support.
B. Notify TPWD Construction Manager of conditions that would adversely affect installation or subsequent utilization of wall system and do not proceed until conditions are corrected.

3.2 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Ensure supports to receive wall system are clean, flat, level, plumb, and square.
C. Aluminum Protection: Where aluminum will contact dissimilar materials, apply a coating of bituminous paint or other neutral material or separate with a nonabsorbent isolator.

3.3 INSTALLATION
A. Install systems level, plumb, square, and accurately aligned, and in accordance with manufacturer's instructions at locations indicated on the approved drawings.
B. Do not install system components with deficiencies or dimensional errors. Do not proceed with installation until unsatisfactory components are replaced.
C. Anchor system securely to supports using attachment methods that permit adjustment for construction tolerances, irregularities, alignment, and expansion and contraction.
D. Install system and related components as required for a complete, weatherproof installation.

3.4 FIELD QUALITY CONTROL
A. Examine installation of sheet metal flashing and sealants.
B. Examine all face sheets for cracks, deep scratches, and other damage, and inspect protective weathering surface of exterior sheet. Repair in accordance with manufacturer's instructions.

3.5 CLEANING
A. Clean system inside and outside, including member connections and inside corners, immediately after installation and after sealants have cured, but not more than 10 days after installation.
B. Follow related cleaning instructions in accordance with manufacturer's recommendations.

3.6 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 08 52 00 – VINYL WINDOWS

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes fixed aluminum windows.

1.2 REFERENCE STANDARDS


1.3 SYSTEM REQUIREMENTS

A. Design and Performance Requirements
   1. Design Test Pressure: Impact, Hurricane rated.
   2. U-Factor: 0.50, maximum.
   3. SHGC: 0.25, maximum.

1.4 SUBMITTALS

A. Product Data: Indicate the performance and accessories for each product. Submit manufacturer’s installation and glazing instructions.

B. Shop Drawings: Indicate size material, and finish. Show internal and surrounding details. Show locations and installation procedures. Include details of joints, attachments, and clearances.

C. Sample: Submit manufacturer’s sample for each finish indicated.

D. Certification: Submit manufacturer’s certification that products meet or exceed specified requirements.

1.5 WARRANTY

A. Warrant the Work specified for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not limited to, the following:
   1. Loose parts.
   2. Leakage.
   3. Noticeable deterioration of finish.

PART 2 – PRODUCTS

2.1 FIXED WINDOWS

A. Manufacturer: PlyGem Windows. Model: 1500 Series Impact Window (Fixed Window & Gliding Window), or TPWD Construction Manager approved equal.
   1. Frames and Sashes: Constructed of vinyl.
   4. Glazing: Factory pre-glazed. Refer to window schedule on Drawings.
PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Before installation, verify that openings are plumb and square and of proper dimension. Report frame defects or unsuitable conditions to the General Contractor before proceeding.

B. Acceptance: Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Use only skilled mechanics for the installation of the windows and components specified within this section.

B. Install windows in strict accordance to manufacturer’s published Installation Instructions.

C. Erect the windows square, plumb and level and furnish adequate anchoring to maintain position and integrity of the windows when subject to normal building movement and windload.

D. Line rough openings with pressure-treated lumber when required by code. Use stainless steel or hot-dip galvanized fasteners and anchors having direct contact with pressure treated lumber.

E. Install sealant and related flashing materials at perimeter of assembly in accordance with manufacturer’s published installation instructions to provide a weather tight seal between the window and the surrounding construction.

3.3 ADJUSTMENT AND CLEANING

A. Clean window frame, glass and components in accordance with manufacturer’s published Care and Maintenance Instructions. Do not remove the permanent ANSI/AAMA or NFRC labels.

B. Leave windows in a job clean condition.

3.3 PROTECTION

A. Cover window, in accordance with manufacturer’s published Care and Maintenance Instructions, during spray painting or other construction operations (such as muratic acid washing after completion of masonry) that might cause damage.

END OF SECTION 08 52 00
SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes:
   1. Commercial door hardware for the following:
      a. Swing doors
      b. Other doors to the extent indicated.
   2. Cylinders for doors specified in other Sections.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   2. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

C. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
   1. Content: Include the following information:
      a. Type, style, function, size, label, hand, and finish of each door hardware item.
      b. Identification number, location, and material of each door and frame.
      c. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      d. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      e. Fastenings and other pertinent information.
      f. Explanation of abbreviations, symbols, and codes contained in schedule.
      g. Mounting locations for door hardware.
      h. List of related door devices specified in other Sections for each door and frame.
      i. Door and frame sizes and materials.
      j. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
   2. Submittal sequence: Submit Door Hardware Schedule at earliest possible date particularly where approval of the door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule.

D. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.
E. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.3 QUALITY ASSURANCE

A. Supplier Qualifications; Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with contractor, TPWD Construction Manager, and Owner about door hardware and keying.
   1. Scheduling responsibility: Preparation of door hardware and keying schedules.

B. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

C. Regulatory Requirements:
   1. Comply with Americans with Disabilities Act (ADA), “Accessibility Guidelines for Buildings and Facilities (ADAAG),” and the “Texas Accessibility Standards” as follows:
      a. Handles, pulls, latches, locks, and other operating devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
      b. Door closers at interior: Hinged doors: 5 pounds maximum opening force applied perpendicular to door.
      c. Thresholds: Not more than ½ inch high. Bevel raised thresholds with a slope of not more than 1:2.
   2. NFPA 101: Comply with the following for means of egress doors:
      a. Latches, locks, and exit devices: Not more than 15 pounds to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
      b. Delayed – egress locks: Lock releases within 15 seconds after applying a force not more than 15 pounds for not more than 3 sections.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
   1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

F. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys to Owner by registered mail or overnight package service.

1.5 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner and TPWD Construction Manager.

PART 2 - PRODUCTS

2.1 HARDWARE

A. Refer to A.820 Door Schedules for types of hardware sets and special hardware.

B. Basis of Design:
   1. Exterior Lever Sets: Hager 3400 Series, Grade 1, Archer lever.
   2. Interior Lever Sets: Hager 2500 Series, Grade 2, Archer lever.

C. Finish: US26D Satin Chrome

D. Keying: All cylinders are to be keyed, master keyed, and grandmaster keyed as directed by owner. Hardware shall be keyed by manufacturer.

2.2 FABRICATION

A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by TPWD Construction Manager. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness.
   1. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18 for finishes.
   2. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws.
   1. Provide screws according to commercially recognized industry standards for application intended. Provide 3" screws at strikes for all security doors, inside and outside.
   2. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
3. Steel machine or wood screws: For the following fire-rated applications:
   a. Mortise hinges to doors.
   b. Strike plates to frames.
   c. Closers to doors and frames.
4. Steel through bolts: For the following fire-rated applications, unless door blocking is provided:
   a. Surface hinges to doors.
   b. Closers to doors and frames.
   c. Surface-mounted exit devices.
5. Fasteners for wood doors: Comply with requirements of DHI WDHS.2, “Recommended Fasteners for Wood Doors.”

PART 3 - EXECUTION

3.1 PREPARATION

A. A. Steel Doors and Frames: Comply with DHI A115 series.
B. Surface-applied door hardware: Drill and tap doors and frames according to SDI 107.
C. Wood Doors: Comply with DHI A115-W series.

3.2 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   2. Wood doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
B. Install each door hardware item to comply with manufacturer's written instructions.
   1. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections.
   2. Do not install surface-mounted items until finishes have been completed on substrates involved.
   3. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   4. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07 92 00 Joint Sealants.

3.3 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit.
   1. Replace units that cannot be adjusted to operate as intended.
   2. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
3. Interior door closers: Adjust sweep period so that, from an open position of 70
degrees, the door will take at least 3 seconds to move to a point 3 inches from
the latch, measured to the leading edge of the door.

3.4 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Protect and clean any paint from hardware.

C. All Rated plates and indications to remain visible. Do not paint hinges or other hardware
finishes.

D. Clean operating items as necessary to restore proper function and finish.

E. Provide final protection and maintain conditions that ensure door hardware is without
damage or deterioration at time of Substantial Completion.

END OF SECTION 08 71 00
SECTION 08 80 00 – GLAZING AND MIRRORS

PART 1 – GENERAL

1.1 SCOPE

A. The Work of this Section includes glazing and mirrors for the following products and applications:
   2. Doors.
   3. Windows.
   4. Wall – mounted mirrors with shelf.

B. Refer to other Sections for design wind pressure and thermal performance requirements for fully-assembled products.

1.2 SUBMITTALS

A. Product Data

B. Glazing Schedule: List glass types and thicknesses for each opening size and location. Use same designations indicated on Drawings.

C. Samples: Provide Sample of each product.

1.9 QUALITY ASSURANCE

A. Comply with written instructions of glass product manufacturers; IGMAs “Glazing Manual” and publications of AAMA, LSGA, and SIGMA as applicable to products indicated, unless more stringent requirements are indicated.

B. Insulating-Glass Units: Permanently mark with appropriate certification label of one of the inspecting and testing agencies indicated below:
   1. Insulating Glass Certification Council (IGCC).
   2. Associated Laboratories, Inc. (ALI).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.
PART 2 – PRODUCTS

2.1 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality q3.

B. Heat-Treated Float Glass: ASTM C 1048, Type I, Class 1 (clear), Quality q3, Kind FT (fully tempered).

2.2 MIRRORS

A. Wall-mounted Mirrors, RE: Interior Elevation Drawings for sizes.
   1. Glass: Unframed, float, ¼ inch thick; Class 1, mirror glazing quality.
   2. Silvering: Quality q1 silver coated per FS-DD-M-411C and ASTM c1503
   3. Guarantee: 5 years against silver spoilage.
   4. Edges: Rounded off and polished.
   5. Mastic: Asphalt mirror setting cement approved by mirror manufacturer.

2.3 FABRICATED GLASS PRODUCTS

A. Sealed Insulating-Glass Units: Factory-assembled units, with two sheets of glass separated by a dehydrated space complying with ASTM E 774.
   a. Sealing System: Dual seal.
   b. Spacer: Manufacturer’s standard stainless steel type.

2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.5 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers’ written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   4. Colors of Exposed Glazing Sealants: As selected by TPWD Construction Manager from manufacturer’s full range.
B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

F. Mirror Mastic: Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

2.8 GLASS TYPES

A. Glass Type G1: Impact Resistant
   1. Thickness: 7/8"
   2. One Lite of Low E

B. Glass Type G2: Single glazing (interior applications).
   1. Thickness: 6.0 mm
   2. Lite: Fully Tempered float glass
   3. Provide safety glazing labeling
C. Glass Type G3: Obscure Impact Resistant Glazing (Restroom Skylights).

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.
F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 MIRROR INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

B. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08800
DIVISION 9      FINISHES

SECTION 09 21 00 – GYPSUM BOARD ASSEMBLIES

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes:
   1. Interior gypsum board assemblies.
   2. Tile backing panels.
   3. Metal furring.
   4. Trim accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. Note: No gypsum board materials from China to be used on this Project.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Gypsum.
   2. CertainTeed Corp.
   3. Georgia-Pacific Gypsum LLC.

C. Gypsum Board, Type C: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M with moisture- and mold-resistant core and paper surfaces.
   1. Thickness: 5/8" inch.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.2 METAL FURRING
2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047, Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.

B. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape: Paper.

C. Joint Compound: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.
F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations and trim edges with edge trim where edges of panels are exposed.

H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Wallboard Type: As indicated on Drawings.
   2. Type X: As indicated on Drawings.
   3. Ceiling Type: Type C as indicated on Drawings.


C. Multilayer Application:
   1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
   2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
   3. On furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
   4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 APPLYING TILE BACKING PANELS

A. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer’s written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by TPWD Construction Manager for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile or other sheet-applied finish.
   3. Level 3: Where indicated on Drawings.
   4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

E. Primer and its application to surfaces are specified in Section 09 90 00 Interior Painting.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 00
SECTION 09 30 00 – TILING

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes:
   1. Ceramic tile.
   2. Setting materials.

1.2 PREFERENCE STANDARDS

A. Definitions and methods in the ANSI A108 series of tile installation standards apply to Work of this Section unless otherwise specified.

1.3 SUBMITTALS

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

B. Samples for each type of tile and grout indicated.

1.4 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Preinstallation Conference: Conduct conference at Project site.

D. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer’s written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

B. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

A. Tile Type W-3: Decorative Wall Tile – Restrooms & UNI1-UNI5.
   1. Manufacturers: DalTile; Division of Dal-Tile International Inc.
   2. Module Size: 12” x 24”.
   3. Thickness: 3/8”.
   4. Face: Plain with modified square edges or cushion edges.
   5. Finish: Gloss.
   7. Grout Color: As selected by TPWD Construction Manager.
   8. Trim Units:

2.4 SETTING MATERIALS

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Boardi Products; a QEP company.
      b. Bonsal American; an Oldcastle company.
      c. Bostik, Inc.
      d. C-Cure.
      e. Custom Building Products.
      f. Jamo Inc.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

B. **Latex-Portland Cement Mortar (Thin Set): ANSI A118.4**
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Boardi Products; a QEP company.
      b. Bonsal American; an Oldcastle company.
      c. Bostik, Inc.
      d. C-Cure.
      e. Custom Building Products.
      f. Jamo Inc.
      g. Laticrete International, Inc.
      h. MAPEI Corporation.
      i. Mer-Kote Products, Inc.
      j. Southern Grouts & Mortars, Inc.
      k. Summitville Tiles, Inc.
      l. TEC; a subsidiary of H. B. Fuller Company.
   2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.
      a. TEC; a subsidiary of H. B. Fuller Company.

2.5 **GROUT MATERIALS**

A. **Polymer-Modified Tile Grout: ANSI A118.7**
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. C-Cure.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
      e. Southern Grouts & Mortars, Inc.
   2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
   3. Polymer Type: Acrylic resin or in liquid-latex form for addition to prepackaged dry-grout mix.

2.6 **ELASTOMERIC SEALANTS**

A. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

B. **One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.**
1. Products: Subject to compliance with requirements, provide one of the following:
   a. DAP Inc.; [Titanium Enriched Kitchen and Bath Sealant] [100 percent Silicone Kitchen and Bath Sealant].
   b. Dow Corning Corporation; Dow Corning 786.
   c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
   e. Pecora Corporation; Pecora898 Sanitary Silicone Sealant.
   f. Tremco Incorporated; Tremsil 600 White.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
   1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
   2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers’ written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
2. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with TPWD Construction Manager.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

B. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCA’s “Handbook for Ceramic Tile Installation” for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series “Specifications for Installation of Ceramic Tile” that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with 1/16 inch (1.6 mm) joints.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
3.4 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter. Remove latex-portland cement grout residue from tile as soon as possible.
   1. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   2. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 30 00
SECTION 09 90 00 – PAINTING AND STAINING

PART 1 – GENERAL

1.1 SCOPE:

A. The Work of this Section includes:
   1. Surface preparation and field painting of exposed exterior and interior items and surfaces.
   2. Surface preparation and field staining of interior items.
   3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

1.2 GENERAL:

A. Paint exposed surfaces, except where paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors.

B. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

C. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Representative Samples: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate. Resubmit until required sheen, color, and texture are achieved.
   1. Painted and Stained Wood: Provide two 12-inch-square samples of each color and material on hardboard.
   2. Painted Gypsum Board: Provide two 3’ x 3’ samples of each color and material.

B. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples. Provide full-coat finish samples on at least 100 sq.ft.
   1. Final acceptance of colors will be from job-applied samples.
   2. The TPWD Construction Manager will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface according to the schedule or as specified.

C. Paint Schedule: Submit record of paint schedule for inclusion in maintenance manual.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.

B. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
C. Material Compatibility: Provide fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer’s original, unopened packages and containers bearing manufacturer’s name and label.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F or per manufacturer’s instructions. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

C. Store remaining materials in location approved by Owner.

1.6 PROJECT CONDITIONS

A. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

B. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F and 90 deg F.

C. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements, provide products by one of the following:
   1. Sherwin Williams.
   2. Benjamin Moore.

B. Material Quality: Provide manufacturer’s best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer’s product identification will not be acceptable.

2.2 COLORS

A. Selections: Colors are to be selected through sample process.

B. Pricing: Provide pricing for the following in the Base Sum.
   1. 4 exterior colors on the building, max.
   2. 5 interior colors for gypsum board, max.

C. Provide unit cost for each additional interior gypsum board color with a matching wood enamel paint.

2.3 FINISHES

A. Verify with TPWD Construction Manager:
   1. Interior Walls – Satin.
PART 3 – EXECUTION

3.1 PREPARATION

A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

B. Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.

C. Remove hardware, hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item or installation method, provide surface-applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

D. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces. Refer to manufacturer’s written instructions for each particular substrate condition.

   1. Provide barrier coats over incompatible primers or remove and re-prime.
   2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
      a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
      b. Prime edges, all exposed surfaces of cabinetry, counters and cases. Paint primer to be white.
      c. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

E. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by TPWD Construction Manager.

3.2 MATERIALS PREPARATION:

A. Mix and prepare paint materials according to manufacturer’s written instructions.

B. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
C. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION:

A. Apply paint according to manufacturer’s written instructions.

B. Use applicators and techniques best suited for substrate and type of material being applied.

C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer’s recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until previous coat has cured to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or loose adhesion. Sand between applications where sanding is required to produce an even smooth surface.

D. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Reccoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

E. Finish Coats: Apply a minimum of TWO COATS OF FINISH COLOR over prime coat. Reccoat as required to ensure NO burns, streaks, or uneven paint due to touch up until paint film is of uniform finish, color, and appearance.

F. Staining: At all interior staining, provide one coat of water-based, transoarent stain and two coats of water-based, clear, satin varnish.

G. Apply paint to all exposed surfaces, including areas visible when permanent or built-in items are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

H. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

I. Paint backside of access panels and removable or hinged covers to match exposed surfaces.

J. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

K. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
3.4 CLEAN UP

A. At the end of each workday, dispose of empty cans, rags, rubbish, and other discarded paint materials.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

END OF SECTION 09 90 00
SECTION 099000 – PAVEMENT MARKING

PART 1 - GENERAL

A. Summary: Section includes parking striping, handicapped stall graphics, and fire lane marking work.

B. Related Work:
   1. General: Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.
   2. Section 32 13 13 - Cement Concrete Paving.
   3. Section 03 30 00 – Cast-in-Place Concrete: General requirements for poured-in-place concrete.

C. Submit: product data; include surface preparation, product handing and application requirements.

PART 2 - PRODUCTS

A. Pavement Marking Paint: FS TT-P-115, Type I, or AASHTO M248, Type N; Pittsburgh11 line Traffic and Zone Marking Paint, Sherwin-Williams A300/A301 Set Fast Premium Alkyd Traffic Marking Paint, or ICI Coatings 442XX Alkyd Traffic-Line Paint. Provide "White" color for line work, "Blue" color for handicapped marking, and "Red" for fire lanes, unless otherwise indicated.

B. Latex Water-Base Emulsion Type Pavement Marking Paint: FS TT-P-1952; Pittsburgh 11 line Traffic and Zone Marking Paint, Sherwin-Williams TM2116/2117 Set Fast Quick Dry Latex Traffic Marking Paint. Provide "White" color for line work, "Blue" color for handicapped marking, and "Red" for fire lanes, unless otherwise indicated. Provide white stenciled "No Parking - Fire Lane" marking complying with requirements of authorities having jurisdiction.

PART 3 - EXECUTION

A. Preparation: Confirm that asphalt and concrete paving has cured a minimum of 30 days and that pavement surfaces are dry before starting pavement marking. Sweep and clean surface to remove loose material, dust and debris. Carefully and accurately lay out the location and termination of traffic and lane markings at the locations indicated.

B. Application: Apply paint with airless spray equipment with wing to limit overspray. Produce pavement markings of 4" uniform width, with straight edges and accurately aligned with layout lines. Apply paint at the rate of 15 mils wet film thickness (100 to 150 sq. ft./gal.) in accordance with manufacturer's printed instructions.

C. Curing and Protection: Barricade pavement areas to prevent traffic until coatings are completely cured and ready to receive traffic in accordance with coating manufactures printed instructions and recommendations.

END OF SECTION 099000
SECTION 099600 - HIGH PERFORMANCE COATINGS

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 WORK INCLUDED:

A. Section includes exterior painting of metal work.

B. Products provided and supplied under this Section are special coating materials requiring applicable expertise in surface preparation, application, and safety procedures.

C. Materials, tools, equipment, and scaffolding required for surface preparation and application of special coatings in locations scheduled.

1.3 REFERENCES:

A. Applicable Standards: Conform to the following Standards:

ASTM B 117: Method of Salt Spray (Fog) Testing

ASTM D 522: Test Method for Elongation of Attached Organic Coatings with Conical Mandrel Apparatus

ASTM D 1653: Method B, Wet Cup, Moisture Vapor Transmission

ASTM D 2246: Method of Testing Finishes of Primed Metallic Substrates for Humidity-Thermal Cycle Cracking

ASTM D 4060: Practice for Testing Abrasion Resistance of Coatings by Taber Abrasion

ASTM D 3273: Fungal Resistance

ASTM D 3359: Method for Measuring Adhesion by Tape Test

ASTM D 4141: Method C (EMMAQUA) Solar Concentrating Exposures of Coatings

ASTM D 4541: Method for Pull-off Strength of Coatings Using Portable Adhesion-Testers

ASTM D 4585: Practice for Testing the Water Resistance of Coatings Using Controlled Condensation

ASTM D 4587: Fluorescent UV-Condensation Exposures of Paint and Coatings

ASTM D 6386: Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

ASTM G 53: QUV Exposure
Fed. Std. No. 141 Method 6192: Test Method for Abrasion Resistance of Coatings by the Taber Abraser

FS TT-C-550c: Coating System Glaze, High Performance for Interior Surfaces


SSPC - SP1: Solvent Cleaning
SSPC - SP2: Hand Tool Cleaning
SSPC - SP3: Power Tool Cleaning
SSPC - SP6: Commercial Blast Cleaning
SSPC - SP7: Brush-off Blast Cleaning
SSPC - SP10: Near white Metal Blast Cleaning
SSPC - SP11: Power Tool Cleaning to Bare Metal
SSPC - SP13: Surface Preparation of Concrete

1.4 SUBMITTALS:

A. Product Data:
   1. Submit manufacturer’s descriptive literature fully describing each product and solids by volume contents.
   2. Include manufacturer’s recommendations for mixing, thinning, application and curing.
   3. Submit manufacturer’s product data sheets.
   4. Submit special coating schedule indicating locations and applications by manufacturer’s name and product number.

B. Samples:
   1. Submit manufacturer’s standard colors for selection by TPWD Construction Manager.
   2. Submit two (2) 12” x 12” samples of each coating system in selected colors on substrate sample to be finished.
   3. Indicate finish texture and color.

C. Test Samples:
   1. When requested by TPWD Construction Manager, obtain test samples from material stored at project site of source of supply.
   2. Retain all paint cans and lids on site until authorized to discard by TPWD Construction Manager.

D. Certificates: Manufacturer’s certified test report from acceptable independent testing laboratory indicating coatings comply with performance requirements.
1.5 QUALITY ASSURANCE:

A. Applicator Qualifications:

1. Applicator shall have minimum five years experience applying special coating materials.
2. Applicator shall be suggested or pre-approved by manufacturer for this application.
3. Applicator shall employ skilled mechanics to ensure highest quality workmanship. Materials to be applied by craftsman experienced in use of specified products.
4. Submit documentation of following minimum applicator qualifications:
   a. Minimum five years commercial experience applying specified manufacturer's industrial grade coatings.
   b. Minimum five successful projects of similar scope and complexity.
   c. List of references for completed projects.

B. Pre-application Conference: Prior to making field samples and placing order for materials, the installer shall schedule a meeting with the TPWD Construction Manager, Owner, General Contractor and manufacturer's representative to agree on methods and schedule for application.

C. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of coating systems that contain volatile organic compounds (VOC).

D. Field Quality Control:

1. Installer shall request acceptance by TPWD Construction Manager of each coat before applying succeeding coats.
2. Furnish and maintain at Project site following fully calibrated testing and inspection devices:
   a. Wet Mil Gauge
   b. Dry Film Gauge with Calibration Shims.
   c. Holiday Detector.
   d. Tooke Destructive Mil Gauge.
   e. Sling Psychrometer.
3. Initiate and maintain for duration of Project field quality control program using certified calibration and testing devices and to ensure conformance with application requirements.
4. Thickness of coatings and paint shall be measured checked according to the procedures outlined in SSPC-PA 2 “Measurement of Dry Film Thickness with Magnetic Gages” with particular attention to section(s) 4.0, 7.8, 7.9, 7.11, 7.13, 7.14, with a non-destructive, magnetic-type thickness gauge that has been calibrated according to the procedures outlined in SSPC-PA 2 “Measurement of Dry Film Thickness with Magnetic Gages” with particular attention to section(s) 3.0, 7.4, 7.5, 7.15. Pass/fail criteria shall require that ninety (90) percent of the spot measurements (average of 3 gauge readings within a 1.5 inch diameter area) be at or above the minimum specified dry film thickness. Of the remaining ten (10) percent of the spot measurements (average of 3 gauge readings within a 1.5 inch diameter area) that are below the minimum specified dry film thickness,
they shall be no less than ninety (90) percent of the minimum specified dry film thickness. Areas that fail to meet these criteria shall be corrected at no expense to the Owner. Use of an instrument such as a Tooke Gauge, precision groove grinder, etc. is permitted if a destructive test is deemed necessary by the TPWD Construction Manager and the total DFT is less than 50 mils.

E. Tests: Where there is any question of dryness of surfaces, test surfaces, test in the presence of the TPWD Construction Manager with a reliable electronic moisture meter.

1.6 MOCK-UP:

A. Apply each coating on minimum 100 square feet of area for each type of coating material.

B. Mock-up will be used to judge quality and finish of completed work.

C. Leave approved mock-up in place as part of completed work if mock-up can be incorporated into work in acceptable manner.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials to Project site in original, factory sealed, unopened, new containers bearing manufacturer’s name and label intact and legible, with the following information:

1. Name or title of material.
2. Federal Specification number, if applicable.
3. Manufacturer’s stock number and date of manufacturer.
4. Contents by volume for major pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Store materials in protected and well ventilated area at temperatures between 40° and 90° degrees F., unless otherwise required by manufacturer.

1.8 ENVIRONMENTAL REQUIREMENTS:

A. Apply coating materials only under following prevailing conditions, unless otherwise noted on manufacturer’s product data:

1. Air and surface temperatures shall not exceed minimum or maximum requirements for product to be applied.
2. Do not apply coatings to damp or wet surfaces.
3. Relative humidity is not above 85% and surface temperature is at least 5 degrees F above dew point.
4. Wind velocity must be below 20 mph for exterior applications.

PART 2 - MATERIALS

2.1 MANUFACTURERS:

A. Materials specified are those that have been evaluated for the specific service. Products of the Tnemec Company, Inc. are listed to establish a standard of quality. Equivalent materials of other manufacturer’s may be submitted on written approval of the TPWD Construction Manager. As part of the proof of equality, the TPWD Construction Manager
will require at the cost of the Contractor, certified test reports from a nationally known, reputable and independent testing laboratory conducting comparative tests as directed by the TPWD Construction Manager between the product specified and the requested substitution.

B. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, solids by volume, recommended dry film thickness and certified lab test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service.

C. All requests for product substitution shall be made at least 14 days prior to the bid date.

D. Any material savings shall be passed to the owner in the form of a contract dollar reduction.

E. Manufacturer's color charts shall be submitted to the TPWD Construction Manager at least 30 days prior to coating and/or paint application. The General Contractor and Painting Contractor shall coordinate work so as to allow sufficient time (normally seven to ten days) for coatings to be delivered to the job site.

2.2 SHOP-PRIMER

Surface Preparation: Prepare all welds as per NACE SP0178, Designation D. Abrasive blast all surfaces as per SSPC-SP6 Commercial Blast Cleaning. A minimum angular profile of 2.0 to 3.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287 is required.

Primer: Tnemec Series 90G-1K97 applied at 2.5 to 3.5 dry mils. Thin only with approved thinner, Tnemec 41-2 or 41-3 Thinner.

2.3 EXTERIOR SYSTEMS SCHEDULE:

A. Exterior Exposed Structural Steel

Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation

Surface Preparation: All surfaces must be clean, dry, and free of contaminants. Clean all bare metal, welded areas, and damaged shop primer as per SSPC-SP6 Commercial Blast Cleaning or SSPC-SP11 Power Tool Cleaning to Bare Metal. Feather all edges smooth. An angular anchor profile of 2.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287 is required.

Coating System:

Spot Primer: Tnemec Series 90G-1K97 Tneme-Zinc touch up damaged areas at 2.5 to 3.5 dry mils. Thin only with approved thinner, Tnemec 41-2 or 41-3 Thinner.
2nd Coat: Tnemec Series 66 applied at 3.0 to 5.0 dry mils. Thin only with approved thinner, Tnemec 41-39 or 41-42 Thinner.

3rd Coat: Tnemec Series 1071 Fluoronar applied at 2.0 to 3.0 dry mils. Thin only with approved thinner, Tnemec 41-63 Thinner. Top coat color to be approved by TPWD Construction Manager and Landscape Architect prior to purchase.

Total dry film thickness shall be a minimum of 7.5 mils.

2.4 MIXING & THINNING:
A. Mix and thin materials in strict accordance with manufacturer's latest printed instructions.
B. Do not use material beyond manufacturer's recommended pot life.
C. Project site tinting will not be allowed.
D. Do not split kits of multi-component products.

PART 3 - EXECUTION

3.1 EXAMINATION:
A. Verify surfaces to be coated are dry, clean and ready to accept base coat in accordance with manufacturer's recommendations.
B. Notify Owner's Representative in writing of unacceptable conditions prior to commencing application.
C. Do not begin work until unsatisfactory conditions have been corrected.

3.2 GENERAL PREPARATION:
A. General: Perform preparation and cleaning procedures in strict accordance with coating manufacturer's instructions and as herein specified, for each particular substrate condition.
B. Protect surrounding and adjacent surface in the manner recommended by coating manufacturer.
C. Scrape or grind protrusions flush with surface.
D. Dislodge dirt, mortar and other dry materials by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming and blowing with high-pressure air.
E. Remove oil, wax and grease by scraping off heavy deposits and cleaning with solvent in accordance with SSPC-SP1.
F. Remove sealers and any contaminant that may interfere with penetration of sealer and hardener.
3.3 APPLICATION:

A. Apply in strict accordance with manufacturer's latest printed and published instructions for each product specified.

B. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer. Test with moisture meter, if applicable.

C. Apply additional coats when undercoats, stains or other conditions show through final coat, until coating film is of uniform finish, color and appearance.

D. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. Comply with recommendations of product manufactured for drying time between succeeding coats.

F. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags or other surface imperfections will not be acceptable.

G. Make edges of coatings adjoining other materials clean and sharp with no overlapping. Work material into surface voids and hairline cracks.

H. Provide "Wet Paint" signs as required to protect newly-coated finishes. Remove temporary protective wrappings provided by other for protection of their work, after completion of painting operations.

3.4 CLEANING:

A. Clean, prepare and touch-up coating system where damaged as per manufacturer's instructions.

B. Remove spilled, splashed or splattered finish material from all surfaces.

C. Do not mar surface finish or item being cleaned.

D. Leave storage space clean and in condition required for equivalent spaces in project.

E. During progress of work, remove from project daily all discarded materials, rubbish, cans and rags.

3.5 REPAINTING:

A. Refinish all work which has become damaged or defaced during the course of construction and leave all finishing in clean, neat and perfect condition, acceptable to the Owner's Representative. Replace all broken glass and damaged material directly attributable to work under this Section.

3.6 ACCEPTANCE:

Final acceptance of coatings shall be based upon inspection by the Owner's Representative. Coatings falling below specified and/or scheduled finish and shade shall be redone as required.
without expense to the Owner.

END OF SECTION 099600
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Polyurethane coating system for use as steel pipe internal lining and external coatings, and external coating for ductile iron pipe.

1.2 MEASUREMENT AND PAYMENT:

A. Unit Prices:

1. No separate payment will be made for work performed under this Section. Include cost of polyurethane coatings in contract unit prices for steel pipe or ductile iron pipe.

B. Stipulated Price (Lump Sum): If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES:

A. AWWA C 222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.


H. ASTM G 14 – Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)


J. NACE SP-0188 – Discontinuity (Holiday) Testing of Protective Coatings

K. NAPF 500-03 – Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
L. SSPC-PA 2 - Measurement of Dry Paint Thickness with Magnetic Gauges.


N. SSPC-SP 1 – Solvent Cleaning Surface Preparation

O. SSPC-SP10 - Near-White Metal Abrasive Blast Surface Preparation

P. SSPC-SP11 – Power Tool Clean to Bare Metal

1.4 SAFETY:

A. Secure, from manufacturer, Material Safety Data Sheet (MSDS) for polyurethane coatings and repair materials listed in this Section.

B. Safety requirements stated in this specification and in related sections apply in addition to applicable federal, state and local rules and regulations. Comply with instructions of coating manufacturer and requirements of insurance underwriters.

C. Follow handling and application practices of SSPC-PA Guide 10, and Coating Manufacturer's Material Safety Data Sheet.

1.5 SUBMITTALS:

A. Submit coating manufacturer's catalog sheets, product data sheets, material data sheets and other manufacturer's information for all material provided. Include manufacturer’s recommendation and instructions for surface preparation, application and curing.

B. Quality Control Submittals. Furnish the following:

1. Shop and field applicator's experience with list of references substantiating compliance. Submit references of 5 successful projects completed within the last 3 years for each applicator. Each project listed should be at least 500 linear feet in length, unless otherwise approved by Project Manager.

2. Monitoring records for shop coated pipe, including coating "affidavit of compliance" to requirements of this Section stating that coatings were applied in factory, in accordance with manufacturer’s requirements, and AWWA C222.

3. Factory applied coatings: Coating manufacturer's certification stating that the individual coating applicators have met the qualification certification requirements as specified in this Section.

4. Upon request by Project Manager, provide:

   a. Manufacturer’s coating application Quality Control Manual
   b. Coating Performance Test report with statement that no reformulations have been made subsequent to the coating tests performed for the report.
   c. Current test equipment calibration certificates

5. Provide administrative documents showing that QA/QC personnel in both shop and field are certified as NACE International Coating Inspector (Level III).

6. Field applied coatings: Environmental monitoring records.

1.6 QUALITY ASSURANCE:

A. Shop and Field Coating Applicator’s Experience and Certification:
1. Minimum 5 years’ practical experience in application of the specified products required for Coating Applicator and the coating application supervisor (Certified Applicator).

2. Minimum 2 years’ practical experience in application of the specified coating system required for Coating application personnel who have direct coating application responsibility.

3. Certification by coating manufacturer as an approved coating applicator required for Coating Applicator.

B. Shop: Unless otherwise approved by Project Manager, coating manufacturer’s technical representative to be present for a minimum of three calendar days for technical assistance and instruction at the start of coating operations within the shop. During this visit, technical representative to observe surface preparation and coating application, and conduct or observe tests of coating to ensure conformance with application instructions, recommended methods, and conditions.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Use standard closed containers to prevent gelling, thickening deleteriously or forming of gas within period of one year from date of manufacture.

B. Label each container of separately packaged component clearly and durably to indicate date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name or formula specification, number of coatings together with special instructions. Do not use coating components older than one year.

C. Deliver coating materials to pipe manufacturer in sealed containers showing designated name, batch number, color, date of manufacture and name of coating manufacturer.

D. Store material onsite in enclosures, out of direct sunlight in warm, ventilated and dry area. Protect from freezing.

E. Prevent puncture, inappropriate opening or other action which may lead to product contamination.

1.8 OBSERVATION OF WORK:

A. Provide minimum 5 days advance notice to TPWD Construction Manager before start of coating or lining work to allow for scheduling of shop or field observation.

B. Provide full access to TPWD Construction Manager for all facilities and documentation regarding surface preparation, environmental conditions and coating applications.

C. Observation by TPWD Construction Manager or waiver of observation does not relieve Contractor of his responsibility to perform work in accordance with Specifications.

D. Materials are subject to testing for conformance with this specification.

E. TPWD Construction Manager may retain services of independent, third-party NACE CIP Level III- Certified Inspector for partial or full-time inspection of the work.
PART 2 - PRODUCTS

2.1 GENERAL:

A. Supply coating material in new, undamaged, labeled, unopened containers clearly and durably displaying date of manufacture, manufacturer's batch number, component identification, component color, manufacturer's name and product name. Store and handle in accordance with manufacturer's written instructions. Discard coating material that exceeds manufacturer's recommended shelf life, or is stored improperly, prior to usage, and replace with new material.

B. Clean, prime, and coat surfaces of pipe and fittings in accordance with referenced standards, written instructions by coating manufacturer, and these specifications.

C. Provide coating materials from single manufacturer. Product substitutions during project are not permitted without approval from Project Manager.

2.2 COATING MATERIAL:

A. Coating System: ASTM D16 Type V thermoset, aromatic polyurethane plastic polymer in accordance with AWWA C222 (referred to as a polyurethane system).

B. Acceptable Materials:

1. DuraShield 210, 310 (External), DuraShield 210-61 NSF, 310-61 NSF (Internal), by LifeLast Inc., Pflugerville, TX,
2. Protec II (External), Protec II PW (Internal) by ITW PolySpec/Futura Coatings, Houston, TX,
3. Polyclad 777PL (External), Polyclad 767 (Internal) by Carboline, St. Louis, MO, or approved equal.

C. Cured Coating Properties. In accordance with AWWA C222 except as follows:

1. ASTM E 96 Permeance using Water Procedure BW (App. X1): no more than 0.16 inch-lb.

2.3 SURFACE PREPARATION:

A. The requirements listed below are for surface preparation procedures in the factory. For surface preparation in the field, refer to Part 3 – Execution.

B. Steel Pipe. In accordance with coating manufacturer’s requirements.

C. Ductile Iron Pipe. Prepare surface in accordance with manufacturer’s recommendations and NAPF 500-03.

1. Provide uncoated ductile iron pipe when polyurethane coatings are used. Do not apply asphaltic coating to ductile iron pipe and then attempt to remove prior to polyurethane coating application.
2. Do not apply surface preparation that is designed for steel pipe to ductile iron pipe. Unlike steel surfaces, it is possible to over blast the external surface of ductile iron pipe. Consult ductile iron pipe and polyurethane coating manufacturer regarding method of application and surface preparation to be used.
2.4 FACTORY APPLICATION OF POLYURETHANE:

A. Equipment: As required by manufacturer.

B. Temperature: Minimum 5 degrees F above dew point temperature. Temperature of surface shall not be less than 50 degrees F during application or as per manufacturers recommendation.

C. Humidity: Heating of pipe surfaces may be required when relative humidity exceeds 80 percent.

D. Do not thin or mix resins; use as received. Store resins at temperature above 55 degrees F at all times or as manufacturers recommendation.

E. Application: Conform to coating manufacturer's recommendations. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

F. Recoat only when coating has cured less than maximum time specified by coating manufacturer. When coating has cured for more than recoat time, follow coating manufacturers recommendations for recoating.

G. Cure and perform cure test in accordance with manufacturer’s recommendations prior to handling, inspection, testing, and placement in service.

2.5 FACTORY INSPECTION:

A. Project Manager may inspect coatings at coating applicator's facilities.

B. Inspection procedures to be in accordance with AWWA C222. Conduct inspection any time after coating has reached initial cure. Repair in accordance with manufacturer’s requirements and these specifications.

C. Remove rejected coating from the full length of pipe to bare metal and reapply using proper application methods.

2.6 HOLDBACK COATING SYSTEM:

A. Provide holding primer for corrosion protection of cutbacks or holdbacks compatible with specified joint coating system and weld after backfill requirements, where applicable.

B. Holdback coating to prevent corrosion of prepared pipe ends for duration of storage and construction and recommended for buried exposures.

C. Primer should not result in running or melting of coating and causing toxic fumes when heated during welding on weld after backfill joints.

D. Apply holding primer in accordance with primer manufacturer’s recommendations, but maintain clearances required for proper joint installation as recommended by pipe manufacturer.

E. Ductile Iron Joints: Apply coating to unlined pipe surfaces including inside of bell socket and outside of spigot. Coating thickness on sealing areas of spigot end of pipe exterior: minimum 8 mils (0.008 inch), maximum of 10 mils (0.010 inch). Maximum 10 mils may be
exceeded in spigot end provided maximum spigot diameter as specified by pipe manufacturer is not exceeded and approved by pipe manufacturer.

F. Welded joints:

1. Field welded on the inside: Provide four-inch coating holdback on spigot end and six-inch coating holdback on bell end.
2. Field welded on the outside: Provide six-inch coating holdback on the spigot end, and four-inch coating holdback on the bell end.

2.7 THICKNESS:

A. External Coatings: Minimum DFT of 25 mils (0.025 inch).


C. Thickness Determinations: Use Type 1 magnetic thickness gauge as described in SSPC-PA2 specification. No single gauge reading may be less than specified thickness.

D. Do not accept pipe with deficient coating thickness. If pipe in field is found to have a coating thickness as measured by SSPC PA-2 that is less than the specified thickness, the pipe segment shall be rejected.

2.8 FACTORY REPAIR OF INTERNAL AND EXTERNAL COATINGS:

A. The procedures listed below are for repairs made to internal and external coatings in the factory. For field repairs, see Part 3 – Execution.

B. Defect size is defined as follows: Minor – less than 6 inches by greatest dimension. Major – exceeds 6 inches by greatest dimension.

C. General

1. Repair areas where holidays are detected or coating is visually damaged, such as blisters, bubbles, cuts, or other defects.
2. Provide coating repair materials that are compatible with the shop-applied coating system and approved by coating manufacturer.
3. Provide repair materials as required for the coating system and repair classification.

D. Repair Materials:

1. Provide polyurethane, single use kits that are supplied by parent coating manufacturer.
2. For major repairs in the shop, reapply using plural component spray equipment by a manufacturer certified coating applicator.

E. For internal coatings, five repairs maximum allowed per 100 square feet of pipe for internal linings. If this number is exceeded, pipe must be stripped of lining, re-blasted, and recoated in factory.
PART 3 - EXECUTION

3.1 FIELD ENVIRONMENTAL CONTROLS:

A. General

1. Do not apply coatings when:
   
   a. Surface or ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer.
   
   b. In dust or smoke-laden atmosphere, blowing dust or debris, or under conditions that can cause icing on metal surface.
   
   c. When it is expected surface temperatures may drop below 5 degrees above dew point within 4 hours after application of coating.
   
   d. Whenever relative humidity exceeds 85 percent, or the maximum recommended by the coating manufacturer.

2. When weather conditions dictate, provide and operate heaters and dehumidification equipment to allow pipe surfaces to be prepared and coated as specified and in accordance with the manufacturer's coating application recommendations.

3. Do not proceed with surface preparation and coating application activities until adequate temperature and humidity controls are in place and functioning within environmental limits specified.

4. Monitor ambient temperature, relative humidity, dew point, temperature, and pipe surface temperature (work area only) in strict conformance with manufacturer's requirements, but not greater than 5 hours between measurements. Document and submit environmental monitoring records to Project Manager upon completion, if requested.

3.2 PIPE INSTALLATION:

A. When required by Project Manager, provide services of pipe manufacturer's representative for period of not less than 2 weeks at beginning of actual pipe laying operations to advise Contractor regarding installation including but not limited to handling and storing, cleaning and inspecting, coatings repairs, and general construction methods as to how they may affect pipe coatings.

B. When required by Project Manager, coating manufacturer's technical representative to provide a written report to the Project Manager for each visit. Include copies of test data collected, description of observations, and all recommended corrective actions. Submit within five working calendar days after the visit. After corrective actions are complete, representative to certify application complies with manufacturer's coating application recommendations.

C. Use nylon straps, padded lifts and padded storage skids. Field cuts should be kept to minimum. Repair damage to coating due to handling or construction practices.

D. Just before each section of pipe is to be placed into trench, conduct visual and holiday inspection in accordance with AWWA C222. Repair defects in coating system before pipe is installed.

E. For field-welded joints, drape minimum 18-inch wide strip of heat-resistant material over top half of pipe on each side of the coating holdback to protect from weld spatter.
F. Provide transition from cement mortar lining to polyurethane lining in accordance with coating manufacturer’s recommendations and as approved by Project Manager.

3.3 FIELD REPAIR AND TOUCHUP:

A. Apply repair and touchup materials in conformance with manufacturer’s recommendations.

B. Repair Procedure – Joints:

1. External Joints. Provide heat shrink sleeve. Metal surface must be free of all dirt, dust, and surface corrosion prior to sleeve application. Where corrosion in the holdback area is visible, prepare surface in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal for steel pipe, or NAPF 500-03-03 Power Tool Cleaning for ductile iron pipe.

2. Internal Joints. Prepare surface and provide environmental controls in accordance with manufacturer’s recommendations.

   a. Remove oil or grease by solvent wiping pipe and adjacent coating in accordance with SSPC-SP1, Solvent Cleaning.
   b. Clean pipe surface in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasively blast in the field in accordance with SSPC-SP10, Near-White Metal Blast Cleaning. Clean the full circumference of the pipe and feather the edges of the existing polyurethane coating a minimum of two inches.
   c. Remove loose or damaged pipe lining at joint and repair as specified herein or extend joint lining.
   d. Apply lining material by hand or spray equipment. Provide material that is compatible with shop lining and approved by manufacturer.
   e. Provide a NACE Level II or III inspector experienced with the applied coating system to inspect surface preparation of the joint lining and document application conditions. Submit documentation to Project Manager.

C. Repair Procedure – Field Defects:

1. Repair Materials (subject to Project Manager’s approval):

   a. Heat-applied repair patches
   b. Single use polyurethane coating kits that control mix ratios
   c. Coating manufacturer’s polyurethane coating repair products

2. Repair Procedures:

   a. Solvent clean in accordance with SSPC-SP1 for steel pipe or NAPF 500-03-01 for ductile iron pipe.
   b. Power tool clean in accordance with SSPC-SP11 for steel pipe and NAPF 500-03-03 for ductile iron pipe. Feather the coating and provide overlap in accordance with a manufacturer’s recommendations.
   c. Apply repair material as described above in accordance with manufacturer’s recommendations.
   d. If a heat-applied repair patch is used, do not overlap patches or use more than one patch for a single repair. If repair area exceeds the size of a single patch, use alternate repair method as listed above.
D. Repair Procedure - Thermite Brazed Connection Bonds:

1. Remove polyurethane coating with power wire brush from area on metal surface which is to receive thermite brazed connection.
2. Grind metal surface to shiny metal with power grinder and coarse grit grinding wheel.
3. Apply thermite-brazed connection using equipment, charge and procedure recommended by manufacturer of thermite equipment.
4. Drape minimum 18-inch wide strip of heat-resistant material over top half of pipe on all sides during welding to protect from weld spatter.
5. After welded surface has cooled to temperature below 130 degrees F, apply protective coating repair material to weld, exposed pipe surface and damaged areas of polyurethane coating. A heat-applied repair patch may be used as approved by Project Manager.
6. Do not cover or backfill freshly repaired areas of coating at thermite-brazed connection until repair material has completely cured. Allow material to cure in conformance with manufacturer's recommendations.

END OF SECTION 099713
DIVISION 10   SPECIALTIES

SECTION 10 14 00 – SIGNAGE

PART 1 – GENERAL

1.1 SCOPE

A. The Work of this Section includes:
   1. Panel signage.
   2. Dimensional letter signage.
   3. Post and panel signage.

B. Signage shall be provided as indicated in the Drawings and as required by authorities having jurisdiction.

1.2 SUBMITTALS

A. Product Data: For each product provided.

B. Shop Drawings: For each unit provided.

C. Samples: For panel signage to portray color, finish, and lettering.

PART 2 – PRODUCTS

2.1 PANEL SIGNAGE

A. Rooms: Verify with TPWD Construction Manager.

B. Life Safety Elements, including but limited to:
   1. Building number.
   2. Occupant loads of assembly areas.

C. Accessible Elements, including but limited to:

D. Public Room Signage
   1. Mechanical.
   2. Janitor.
   3. Storage.
   4. Offices.
   5. Kitchen.
   6. Conference.
   7. Restrooms.
   8. Service.
   9. Lobby.
2.2 DIMENSIONAL LETTER SIGNAGE

A. Adhesive Vinyl Letters to identify elements including but not limited to:
   1. Exit door locking at front.
   2. Exit door alarm, no re-entry.

B. Fire Protection: RE: Section 10 44 00.

2.3 POST AND PANEL SIGNAGE

A. Accessible Parking.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install all signage per authority having jurisdiction.

B. Install all signage level, plumb, and in accordance with manufacturer’s requirements.

END OF SECTION 10 14 00
SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 – GENERAL

1.1 SCOPE

A. The work of this Section includes:
      b. Grab Bars.
      c. Baby Changing Station.
      d. Electric Hand Dryer.
      e. Clothes Hook.
      f. Mirrors.
      g. Soap Dispensers.
      h. Paper Towel Dispenser & Waste Receptacle.
      i. NOT USED.
      j. Restroom Partitions.
      k. Shower Rod & Curtain.
      l. Trench Drain.

C. Related Work: RE: Section 08 80 00 Glazing and Mirrors for frameless, wall-mounted mirrors.

1.2 SUBMITTALS

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

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Identify locations and products using designations indicated.

C. Samples: Manufacturer’s finish samples of standard color options for toilet compartments.

1.3 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.

1.4 WARRANTY

A. Manufacturer’s Standard:
   1. One year: Against material defects and workmanship; full replacement.
   2. 25 years: Against breakage, corrosion, delamination, and factory workmanship.
PART 2 – PRODUCTS

2.1 WASHROOM ACCESSORIES

A. Surface Mounted Toilet Tissue Dispenser (TP1): Bobrick, B-2892.
   1. Twin Jumbo Roll
   2. Unit 20 13/16” W, 11 3/8” H, 5 5/16” D
   3. For use with 3” diameter rolls.

   1. Size: 24”, 30”, 36”, 42”, 48”.
   2. Material: 18-gauge, Type 304 stainless steel tubing.
   4. Concealed mounting flange: 1/8" thick x 2" wide x 3 1/8" high, with screw holes for concealed anchors.
   5. Cover: 22-gauge, Type 304 stainless steel with satin finish, 3 1/4" diameter. Cover snaps over mounting flange to conceal screws.

C. Baby Changing Station (BC): Koala Kare, KB110-SSRE.
   1. Mounting: Recess Wall-mounted, horizontal.
   2. Finish: Stainless steel.
   3. Location: As indicated at UNI1 – UNI5.

D. Electric Hand Dryer (HD): WORLD DRYER, SLIMdri.
   1. Mounting: Surface Mounted.
   2. Location: Indicated in Interior Elevation.
   3. Material Type: 304 Stainless

   1. Material: Type 304 Stainless Steel.

F. Mirror (MR): Bobrick B-165.
   1. Mounting: Surface.
   2. Size: 30” x 42” (MR1).
   3. Material: Type 304 Stainless Steel
   4. Finish: Satin
   5. Location: Refer to Interior Elevations.

G. Surface Mounted Soap Dispenser (SD1): Bobrick B-4112.
   1. Material: Type 304 Stainless Steel.
   2. Finish: Satin.

   1. Stainless Steel.
   2. Finish: Satin.
   3. Location: Refer to Enlarged Plans

   1. Stainless Steel.
   2. Finish: Bright Polished.
   3. Location: Refer to Enlarged Plans
I. NOT USED.

   1. 413 Freestanding-Floor Mounted/Overhead Braced.
   2. Location: Refer to Enlarged Plans
   3. Manufacturer: METPAR
   5. Vandal resistant.

K. Shower Rod & Curtain (SR)
   1. 2" diameter galvanized steel tube.
   2. Location: Refer to Enlarged Plans

L. Trench Drain (TD6 = 6' length & TD9 = 9' length)
   1. Manufacturer: NDS.

2.1 UNDERLAVATORY GUARDS

A. Underlavatory Guard:
   1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
   2. Material and Finish: Antimicrobial, molded plastic, white
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.

B. Install units level, plumb, and firmly anchored in locations and at heights indicated.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer’s written recommendations.

END OF SECTION 10 28 00
SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 – GENERAL

1.1 SCOPE
   A. The work of this Section includes:
      1. Portable fire extinguishers.
      2. Cabinets and wall brackets.

1.2 SUBMITTALS
   A. Product Data: Include date on extinguishers and cabinets, brackets, cabinet dimensions, operational features, materials, finishes, and anchorage.
   B. Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

1.3 QUALITY ASSURANCE
   A. Coordinate sizes and locations of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
   B. Provide fire extinguishers complying with applicable code.
   C. Cabinets in Fire Rated Partitions: Tested in accordance with ASTM E814 with fire resistance rating equivalent to adjacent construction.
   D. Conform to applicable accessibility code for locating extinguishers.

PART 2 – PRODUCTS

2.1 MANUFACTURERS
   A. Subject to compliance with requirements, acceptable manufacturers include:
      1. JL Industries. (www.jlindustries.com)
      3. Potter Roemer. (www.potterroemer.com)

2.2 COMPONENTS
   A. Extinguishers:
      1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
      2. Multi-purpose dry chemical type, UL 299, Class 2A: 10B:C, 5 pound nominal capacity.
      3. Finish: Baked enamel, red color.
B. Cabinets:
1. Material: Steel.
2. Configuration: Semi-recessed, sized to accommodate extinguishers. Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation. Locate as directed by TPWD Construction Manager.
3. Trim: Flat trim or returned to wall surface.
5. Solid style, equipped with pull handle and latch.
6. Hinge doors for 180 degree opening.
7. Finish: As selected by TPWD Construction Manager from manufacturer’s standard colors.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
1. Location: Applied to cabinet door.
2. Application Process: Silk-screened
3. Lettering Color: Red
4. Orientation: Vertical

D. Brackets:
1. Manufacturer’s standard, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated.
2. Finish: Plated or backed enamel; to be selected from manufacturer’s full color range.

2.3 ACCESSORIES
A. Mounting Hardware: Type best suited to application.

PART 3 -EXECUTION

3.1 EXAMINATION
A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.

3.2 INSTALLATION
A. Install cabinets and brackets in accordance with manufacturer’s instructions.
B. Set plumb, level, and rigid.
C. Place an extinguisher in each cabinet.

END OF SECTION 10 44 00
SECTION 107516 - GROUND-SET FLAGPOLES

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 ground-set flagpoles made from aluminum.

B. Owner-Furnished Material: Flags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles.

1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.

2. Include section, and details of foundation system.

C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For flagpoles.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 150 mph.
2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

1. Kronberg’s or approved equal.

B. Exposed Height: 30 feet.

C. Construct flagpoles in one piece.

D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

1. Flashing Collar: Same material and finish as flagpole.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch spun aluminum, finished to match flagpole.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Stainless-steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.
2.5  MISCELLANEOUS MATERIALS
    A.  Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.
    B.  Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
    C.  Sand: ASTM C 33/C 33M, fine aggregate.
    D.  Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant.
    E.  Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6  ALUMINUM FINISHES
    A.  Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1  PREPARATION
    A.  Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
    B.  Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
    C.  Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
    D.  Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.
    E.  Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.
    F.  Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.
    G.  Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.
    H.  Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2  FLAGPOLE INSTALLATION
    A.  General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.
B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107516
SECTION 220000 - PLUMBING GENERAL

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Mechanical and Plumbing Work, and General Requirements (if any), apply to the work specified in this section.

1.2 GENERAL REQUIREMENTS

A. Provide materials, equipment and labor to install plumbing as required by applicable codes and as specified herein.

B. Provide water connections to equipment furnished in other sections of this specification and as required by the Texas Parks and Wildlife Department (TPWD) Construction Manager.

C. The Contractor shall furnish all materials and labor as may be required to connect this facility to water main with meter and tap. The Contractor shall include in his bid price the cost of the Department of Public Utilities Water Division inspection fee(s) in addition to the cost of all materials and labor for a complete water service installation.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of plumbing equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer: A firm with at least three (3) years of successful installation experience on projects with plumbing equipment work similar to that required for this project.

C. All plumbing work shall be performed by a Master Plumber licensed by the State of Texas TDLR or under the direct supervision of a Master Plumber, so licensed.

PART 2 – PRODUCTS

2.1 NO PRODUCTS REQUIRED BY THIS SECTION

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install vacuum breakers on plumbing equipment supply lines where contamination of domestic water may occur. Generally necessary of hose bibbs and flush valves.

B. Install trap primer where required by Codes and/or where indicated on drawings.

END OF SECTION 220000
SECTION 220501 - PLUMBING SPECIALTIES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Floor drains.
B. Cleanouts.
C. Backflow preventers.
D. Fixture Carriers.
E. Water hammer arrestors.
F. Hose bibbs, wall hydrants, and tempering valve.
G. Trap Primer.

1.2 RELATED SECTIONS

A. Section 230000 - Mechanical Basic Materials and Methods.
B. Section 230529 - Supports, Anchors and Seals
C. Section 221316 - Plumbing Piping.
D. Section 224000 - Plumbing Fixtures and Trim.

1.3 REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
B. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
D. ANSI A112.21.1 - Floor Drains.
F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
G. PDI WH-201 Water Hammer Arresters.
1.4 SUBMITTALS
   A. Shop Drawings: Indicate dimensions, weights and placement of openings and holes.
   B. Product Data: Provide component sizes, rough-in requirements, service sizes and finishes.
   C. Manufacturer’s Installation Instructions: Indicate assembly and support requirements.

1.5 PROJECT RECORD DOCUMENTS
   A. Record actual locations of equipment, cleanouts, backflow preventers, etc.

1.6 OPERATION AND MAINTENANCE DATA
   A. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 EXTRA MATERIALS
   A. Provide two loose keys for each type of valve box or hydrant.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS:
   A. Floor drains (F.D.) shall be sized to conform to the information indicated on the Drawings or contained elsewhere in these Specifications. Extreme care shall be used to set the elevation of the drain to meet the low point elevation of the finished floor. Each floor drain shall be provided with a P-trap unless noted otherwise. Note that a deep seal type trap may be required under other Sections of these Specifications.
   B. All floor drains will be furnished and installed with all accessories required for the particular construction in which they are to be mounted; and shall be as manufactured by Wade, Josam, Zurn, Smith or accepted substitution.

2.2 CLEANOUTS:
   A. At each change in direction, at the end of each continuous waste line, at the foot of each riser in the building and at 90’ intervals in horizontal runs, cleanouts shall be placed in soil and waste lines and storm drain lines. The size of the cleanouts shall be identical with the size of the pipe line in which they are placed for four inch (4") and smaller lines. The size of cleanouts in lines larger than four inches (4") shall be six inches (6") in all cases. All cleanouts shall be placed to be easily accessible for servicing. Where they occur in pipe chases, they shall be placed above the floor in such a location so they will be easily accessible through access doors, or they shall be brought through the walls and be provided with covers. All horizontal lines shall have a cleanout placed in the end of the line by the use of a wye and a 1/8 bend, or by a combination tee-wye and made easily accessible by extending the cleanout through the wall and be covered as described above. The screw plug of all cleanouts shall be of cast brass or bronze.
B. The bodies of floor cleanouts shall be tapped for iron pipe threads. Wherever such cleanouts occur in finished floor slabs, they shall be provided with scoriated nickel bronze cleanout covers of such a size as to make the plugs over which they are installed readily accessible. These cleanouts shall be cast iron floor cleanout with cut-off ferrule, tapered brass plug with round screwed nickel bronze access cover.

C. Cleanouts at grade shall be installed in a 12" x 12" x 6" thick reinforced concrete pad. Cleanout shall be J.R. Smith 4113S or approved equal by Wade, Josam or Zurn.

D. Final mounting of cleanout or cover shall be set flush with the finished surface the device is mounted in.

2.3 BACKFLOW PREVENTERS:

A. Backflow preventers (BFP) shall be reduced pressure type, Watts Series 909AG. A BFP shall be installed to isolate all non-potable water requirements from the building domestic water system. (All BFPs shall be installed within the building.) Contractor shall submit documentation of certification of all backflow preventers.

2.4 FIXTURE CARRIERS:

A. Water closets: Provide J.R. Smith Series 200, adjustable horizontal and vertical integral carrier fitting, or accepted substitution.

B. Urinal Carriers: Provide Smith Series 600 concealed chair carrier with bearing plate and M31 rectangular steel structural steel uprights or accepted substitution.

C. Lavatory Carriers: For wall hung lavatories, provide Smith Series 700 concealed chair carrier with concealed arms M31 rectangular steel structural steel uprights.

D. Acceptable manufacturers are Smith, Wade, Zurn or Josam.

2.5 WATER HAMMER ARRESTERS

A. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch or battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving mechanical equipment. As shock absorbers, provide Sioux Chief Hydra-Rester, Zurn series Z-1700, Smith series 5000, Josam series 1485 or Wade series "W" with stabilized 18-8 stainless steel casing and bellows. Provide bellow precharged with clinically pure air, completely sealed and operating free of casing. Size all units according to water hammer arresters standard PD1-WH-201.

2.6 TEMPERING VALVE (TV-1)

A. Provide Leonard Model TM-30-E including Type M thermostatic mixing valve, adjustable limit stop, check-stops, volume control/shutoff, thermometer (0-110°F), vacuum breaker on outlet, factory assembled. Equivalent products manufactured by Symmons will be acceptable.
2.7 TRAP PRIMER

A. Install trap primer supply to all floor drains. Provide Precision Plumbing Model P-2 trap primer complete with ball check valve and \( \frac{1}{2} \)-inch NPT inlet and outlet. Provide distribution unit as required. Primer unit installation shall be per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete 1” above proposed grade.

D. Pipe relief from back flow preventer to nearest drain.

E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories and sinks.

F. Lead: It is forbidden that lead in any form be used in any water system. If lead is used in the fabrication or installation of any water system then all of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint and shall be removed from the project site. The system(s) shall then be restored and reinstalled using all new materials.

END OF SECTION 220501
SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Perform all work required to provide and install piping insulation, jackets and accessories indicated by the Contract Documents with supplementary items necessary for their proper installation.

1.2 RELATED SECTIONS

A. Section 230000 - Mechanical Basic Materials and Methods.

B. Section 230553 - Mechanical Identification.

1.3 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.


E. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal


G. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

H. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.


J. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

K. ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.

L. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

M. ASTM C591 - Rigid Preformed Cellular Urethane Thermal Insulation.

N. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.
O. ASTM C640 - Corkboard and Cork Pipe Thermal Insulation.


Q. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.


S. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.


W. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Product Data: Provide product description, list of materials and thickness for each service and locations.

B. Samples: Submit three samples of any representative size illustrating each insulation type.

C. Manufacturer’s Installation Instructions: Indicate procedures which ensure acceptable standards will be achieved. Certificates to this effect shall be submitted.

1.5 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with NFPA 255.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.
PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass Insulation:
   1. Owens-Corning.
   2. Certainteed Manson.
   3. Schuller.
   4. Knauf.

B. Cellular Glass Insulation:
   1. Pittsburgh Corning - Foamglas.

C. Closed Cell Elastomeric:
   1. Armaflex.
   2. Or accepted substitution.

D. Hydrous Calcium Silicate
   1. Owens Corning-Kaylo
   2. Certainteed Fiberglass Insulation.
   3. Schuller.

2.2 HOT AND COLD DOMESTIC WATER

A. All hot and cold water lines in buildings, including valves, strainers, unions, flanges, etc., except where specifically noted to the contrary, shall be insulated.

B. All cold water lines shall be insulated with 1" thick minimum 3 1/2 pound density preformed fiberglass insulation with a factory applied All Service Jacket, vapor sealing all joints and factory performed fittings with vapor seal, or a flexible, 1" thick, "25-50" rated, closed cell elastomeric thermal insulation such as "Self Seal Armaflex 2000." Elastomeric products shall be supplied in a preslit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint. All elastomeric insulating products shall be guaranteed not to react with copper piping. Valves shall be insulated with mitered pipe covering with voids filled with glass fiber blanket insulation. Valves and fittings shall be vapor sealed with a water base asphaltic emulsion. Fittings on concealed insulation shall be built up to the thickness of adjacent insulation with glass fiber fitting wrap and shall be finished with Glasfab tape embedded in vapor barrier emulsion. Exposed fitting insulation shall be built up to same thickness as adjoining pipe insulation with one coat cement and after drying shall be finished with a white vapor seal and canvas jacket secured with "Arabol" adhesive and be suitable for painting. Seams in jacket shall be placed in the least noticeable locations. Where seams, joint or fittings are rough they shall be covered with an application of insulating cement trowelled on smoothly before the canvas is applied with Arabol adhesive. The canvas must be free of wrinkles and have a smooth, neat appearance.

C. All hot water piping systems shall be insulated as specified above for cold water and the insulation thickness shall be one inch (1") thick.
D. The only hot and cold water piping that will not require insulation are the exposed runouts under non-handicap plumbing fixtures. Where pipe chases are tight, adequate provision shall be made at the rough in stage utilizing offset fittings or other means (except springing the pipe) to insure that insulation can be applied throughout the length of the pipe.

E. Hangers shall bear on the outside of the insulation and shall not be in contact with the pipe. Curved metal shields shall be used between the hangers or support points and at the bottom of the insulated pipe. Provide rigid foamglass insulation at each support point, a minimum of 4 inches longer than shield length. Curved metal shields shall be designed to limit the bearing stress on the foamglass insulation to 20 psi and shall be curved to fit up to mid-perimeter of the insulated pipe. Required metal shield sizes are as follows:

<table>
<thead>
<tr>
<th>Nominal IPS</th>
<th>Metal Thickness</th>
<th>Minimum Lengths of Shield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2&quot;</td>
<td>14 gauge</td>
<td>12&quot;</td>
</tr>
<tr>
<td>2 ½&quot; to 6&quot;</td>
<td>1/8&quot;</td>
<td>16&quot;</td>
</tr>
</tbody>
</table>

2.3 CONDENSATE DRAIN PIPING

A. Condensate drain piping from fan and coil units, coil banks and other items of piping or equipment subject to condensation forming on the surface shall be insulated with a minimum of 1/2" thick "25-50" rated, closed cell elastomeric thermal insulation. Elastomeric products shall be supplied in a preslit tubular form with a pressure sensitive adhesive system for closure and vapor sealing of the longitudinal joint. All elastomeric insulating products shall be guaranteed not to react with copper piping.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed and dry.

3.2 INSTALLATION

A. Handle and install materials in accordance with manufacturer’s instructions.

B. On exposed piping, locate insulation and cover seams in least visible locations, but not higher than at the side of the pipe at the "90°" position, with the seam lapped such that the lap is directed down.

C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory applied or field applied.
2. Insulate fittings, joints and valves with molded insulation of like material and thickness as adjacent pipe.
3. Finish with glass cloth and vapor barrier adhesive.
4. Install jacketing. PVC fitting covers shall not be used.
5. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations.
6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.
D. For insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
   2. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe.
   3. Finish with glass cloth and adhesive.
   4. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
   5. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions, including those at equipment, but label the insulation to indicate a concealed flange or union.

E. Inserts and Shields:
   1. Application: All insulated piping at each support point.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert Location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Heavy density insulating material suitable for the planned temperature range and the weight of the pipe.
   6. Manufacturer shall be responsible to size the length of shield required to prevent insulation from breaking.

F. Finish insulation at supports, protrusions and interruptions.

G. For insulated pipe, fittings and valves exposed in mechanical equipment rooms or in finished spaces, finish with aluminum jacket and fitting covers.

H. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

I. All piping requiring insulation shall be insulated as specified herein, and as require for a complete system. In each case, the insulation shall be equal to that specified and materials applied and finished as described in these Specifications.

J. All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.

K. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor’s submittal data for this section of the Specifications. No material may be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
L. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3”). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, strainers and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable.

M. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.

N. Where specified, aluminum bands shall be used on piping insulation. The bands shall be applied three (3) to a section of pipe. Fittings, valves, etc., shall have bands on each side.

O. Where canvas finish is specified, use Arabol lagging adhesive to prevent mildew in securing canvas. Do not use wheat paste. In addition, cover all canvas insulation with a fire retardant coating.

END OF SECTION 220719
SECTION 221316 - PLUMBING PIPING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Mechanical and Plumbing Work and General Requirements (if any), apply to the work specified in this section.

1.2 REFERENCES

A. All work to be as per current Uniform Building, Uniform Mechanical and Uniform Plumbing codes.

B. Welding materials and labor must conform to ASME Code and the applicable state Labor Regulations.

C. Domestic water, drainage and vent piping shall meet the requirements of the Uniform Plumbing Code for the type specified herein.

D. Gas piping shall meet the requirements of A.G.A. Installation Code for natural gas burning appliances and equipment.

E. Use welders fully qualified and certified by authorities having jurisdiction.

1.3 GENERAL REQUIREMENT

A. Piping which is required to provide services across the floor and vehicle traffic areas should be routed overhead as much as possible. All aboveground piping should be readily accessible and available for visual inspection.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of pipe and pipe fittings, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer: A firm with at least three (3) years of successful installation experience on projects with pipe and pipe fittings work similar to that required for this project.
PART 2 – PRODUCTS

2.1 SANITARY DRAIN PIPING – BURIED

A. Cast Iron Pipe: ASTM A74, service weight domestic manufacture.
   1. Fittings: Cast iron, domestic manufacture, bell and spigot, drainage pattern.
   2. Joints: ASTM C564, neoprene gasket system.

B. PVC Pipe: Schedule 40 PVC DWV soil pipe and fittings.

2.2 SANITARY DRAIN PIPING – ABOVE GROUND

A. Cast Iron Pipe: ASTM A74, service weight domestic manufacture.
   1. Fittings: Cast iron, domestic manufacture, bell and spigot, drainage pattern.
   2. Joints: ASTM C564, neoprene gasket system.

B. Cast Iron Pipe: CISPI 301, hubless, service weight, domestic manufacture.
   1. Fittings: Cast iron, domestic manufacture, hubless, drainage pattern.

C. PVC Pipe: Schedule 40 PVC DWV soil pipe and fittings.

2.3 WATER PIPING – ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.
   3. At Contractor’s option, roll-grooved copper pipe with Victaulic grooved copper fittings and Style 606 couplings may be used for piping 2 ½ inches and larger.

   1. Fittings: ProPEX ASTM F1960

2.4 NATURAL GAS PIPING – ABOVE GRADE

A. Steel Pipe: ASTM A53 Grade A or B, Schedule 40 black.
2.5 FLANGES, UNIONS, AND DIELECTRIC CONNECTIONS

A. Pipe Size 2 Inches and Under:
   1. Ferrous pipe: 300 psig WOG, malleable iron, threaded unions, galvanized for galvanized piping systems.
   2. Copper tube and pipe: 250 psig WOG, bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:
   1. Black steel pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
   2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.
   3. Galvanized steel pipe: 300 psig WOG rating, galvanized ductile or galvanized malleable iron, hinged two-piece design with EPDM gasket, designed for installation on cut-grooved steel pipe. Victaulic Model No. 741 or equal as manufactured by Gruvlok.

C. Dielectric Connections: Union with galvanized steel threaded end, copper solder end, water impervious isolation barrier. Dielectric flange isolation kits for larger diameter piping. Union with female iron pipe threads each end, black malleable iron, with insulator, for gas piping systems.

2.6 DOMESTIC WATER SHUT-OFF VALVES

A. Manufacturers: Nibco or approved equal, domestic manufacturer.

B. For piping requiring insulation, furnish ball valves with "Nib-Seal" insulated handle or extended stem for other manufacturers.

C. 2 Inches and Smaller: Nibco Model No. T-585-70-66 ball valve; 600 psig WOG rated, bronze or brass body, threaded ends, two-piece body, full port, plastic-coated zinc-plated steel handle, TFE seats and packing, stainless steel stem and ball.

D. 2 ½ Inches and Larger: Nibco Model No. LD 3022 butterfly valve; 250 psig WOG rated, ductile iron lug style body, extended neck design, stainless steel stem, EPDM stem seal, EPDM molded-in liner and stainless steel disc. Provide lever lock operator for 2 ½ inch through 4 inch valves and gear operator for larger valves.

E. Manufacturers: Uponor

F. 2 inch ProPEX LF brass commercial ball valve (full port).

G. ½ inch brass ball valve (large bore).

2.7 CHECK VALVES

A. Manufacturers: Nibco or approved equal, domestic manufacturer.

  1. 2 Inches and Smaller: Nibco Model No. T-433-B; 300 psig WOG rated, swing check, bronze body, bronze disc, screwed ends.
2. 2 ½ Inches and Larger: Nibco Model No. F-918; 200 psig WOG rated, swing check, bolted bonnet, renewable seat and disc, bronze disc or ductile iron disc with bronze face ring, bronze seat ring, cast iron body, flanged ends.

3. Valves in Domestic Water Pump Discharge Lines (2 Inches and Larger): Nibco Model No. W-920-W; 200 psig cold water working pressure rated, twin disc, water style, cast iron body, Buna-N seat, aluminum bronze disc, stainless steel hinge pin and spring.

2.8 DOMESTIC HOT WATER RETURN BALANCING VALVES

A. Manufacturer: Armstrong Model No. CBV-T.

2.9 WATER PRESSURE REDUCING VALVES

A. Manufacturers: Other acceptable domestic manufacturers offering equivalent products will be considered.

B. 1 Inch and Smaller: Watts Model No. 223SB; bronze body with integral bronze strainer, built-in by-pass feature, direct acting design, renewable stainless steel seat, threaded ends, rated for 300 psig inlet pressure, outlet pressure adjustable from 25 to 75 psig.

C. 1 ¼ Inch and Larger: Cla-Val Model No. 90G-01ACJ; pilot-operated, screwed ends for sizes 2 inch and smaller and Class 150 flanged ends for sizes 2 ½ inch and larger, 30 to 300 psig adjustment range, stainless steel trim, cast iron body, FDA approved epoxy coated inside, strainer on pilot operating control line, closing speed control and flow stabilizer.

2.10 RELIEF VALVES

A. Combination Temperature and Pressure Relief Valves: Watts, or approved equal, domestic manufacturer, bronze body, reseating type, test lever, capacities ASME rated and design certified by AGA, certification label attached to valve, temperature sensing element length as required for immersion in water within the top 6 inches of the tank.

B. Pressure Relief Valves: Kunkle Model No. 20M, or approved equal, domestic manufacturer, bronze body, stainless steel seat and disc, at all locations except for pressure reducing valve stations. At pressure reducing valve stations, pressure relief valves to be Cla-Val Model No. 50-01 with Model No. X105L limit switch assembly.

2.11 STRAINERS

A. Manufacturers: Watts, or approved equal, domestic manufacturer.

B. Size 2 Inch and Under: Bronze body for 200 psig water working pressure, Y pattern with 20 mesh stainless steel strainer screen, screwed ends.

C. Size 2 ½ Inch and Larger: Flanged iron body for 200 psig water working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
PART 3 – EXECUTION

3.1 PREPARATION

A. Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

3.2 ROUTE AND GRADES

A. Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping whenever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.

B. Slope water piping 1 inch in 40 feet (1:500) and arrange to drain at low points.

C. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.

D. Slope all drainage piping uniformly at ¼ inch per foot, or as indicated on Drawing. Where not possible, piping 3 inch and larger may be sloped at 1/8 inch per foot.

3.3 INSTALLATION

A. Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

B. Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

C. Install piping material, specified as inside the building to 5 feet outside of building, except where noted on Drawings.

D. Install in accordance with manufacturer’s instructions and the Texas Parks and Wildlife Department requirements.

E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

F. Provide companion flange or unions at proper points so that piping may be dismantled for replacement of strainers, traps, valves or similar devices and at connections to equipment.

G. Route piping in orderly manner and maintain gradient.

H. Group piping whenever practical at common elevations.

I. Provide access where valves and cleanout fittings and similar equipment are not exposed. Coordinate size and location of access doors with Uniform General Conditions & Special Conditions.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 9.

L. Install bell and spigot pipe with bell end upstream.

M. Ensure adequate space exists for valved operation and service.

N. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

O. Install valves for shut-off and to isolate equipment, parts of systems (branches) or vertical risers, even if not indicated on Drawings.

P. Do not install copper piping in direct contact with ferrous metals, e.g. metal studs, steel angles, channels, beams, joists or metal pans. Wrap pipe, three complete wraps minimum, with self-adhering, friction cloth tape.

Q. At every plumbing fixture and piece of equipment requiring a water connection, provide manufactured shock arresters on both hot and cold water connections whether shown on Drawings or not. At fixture manifolds, common shock arresters may be installed. Sizing and placement of shock arresters to be in strict conformance with the manufacturer's recommendations.

R. Install 2 inch minimum drainage pipe size for tubs, showers, lavatories and sinks.

S. Provide reducers, increasers and special adapters or fittings that may be required between piping work and fixtures or equipment to complete the installation.

T. Use fittings at changes of direction in piping systems. Do not bend pipe. Utilize reducers or increasers at pipe size changes. Bushings or reducing couplings of any design are not acceptable.

U. Install chrome plated or similar work or equipment free of wrench marks.

V. Pitch hot and cold water piping to drain with shut-off valve and hose thread adapter installed at each low point.

W. Follow the basic design of waste and vent arrangements shown on Drawings without deviation. Advise the Texas Parks and Wildlife Department (TPWD) Construction Manager of conflicts and receive approval before deviating from the design indicated.

X. Securely anchor hot and cold water piping inside wall and chase construction to fire treated nominal 2 inch thick wood secured between wall studs to prevent movement of plumbing fixture trim.

Y. Provide metallic chrome plated or stainless steel escutcheons or plates around pipes exposed to view when passing through walls, partitions or ceilings. Size to fit pipe or insulation and anchor in place.

Z. Ground all gas inside building. Provide ground rod, clamps, conductors, etc., in accordance with Article 250 of the National Electric Code, and ground all gas piping within the building.
3.4 APPLICATION

A. Sanitary tapped tee fittings may be used in the vertical position above the floor for connecting fixtures.

B. Hubless cast iron sanitary drainage piping and standard CISPI coupling joints may only be used at fixture manifolds, branch sanitary waste piping and branch sanitary vent piping beginning 6 inches above the flood level rim of the fixture served. Hubless cast iron sanitary drainage piping with Clamp-All "Hi-Torq 80", Mission or Huskey coupling joints may be used on sanitary soil/waste and vent stacks, stack offsets and storm/overflow piping above ground.

C. Where adequate clearances do not exist, sanitary drainage piping may be copper pipe and DWV fittings. 1 ½ inch sanitary vent piping may be copper pipe and DWV fittings.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.

H. Provide written certification that these procedures were performed.

3.6 TESTING AND ADJUSTING

A. Test domestic hot and cold water systems hydraulically to a pressure of 100 psig or 1 ½ times working pressure, whichever is greater, for a period of four hours.

B. Repair leaks, replacing materials as necessary and retest until systems prove to be free of leaks.

C. Test sanitary waste and vent piping by plugging all openings and pressurizing the systems to the height required by City inspector. Inspect all joints, repair leaks found, and retest until piping is demonstrated to be free from leaks. Apply peppermint or smoke test as, and if, required by local code.

D. Test natural gas piping systems in accordance with Texas Parks and Wildlife Department requirements.

E. Conduct tests before backfilling trenches, covering is applied and prior to closing in of construction. Tests may be performed in sections as completed.
F. Final tests shall be witnessed and approved by the Texas Parks & Wildlife Department (TPWD) Construction Manager.

G. Demonstrate to the Texas Parks and Wildlife Department (TPWD) Construction Manager that entire installation, and all components are functioning properly.

END OF SECTION 221316
SECTION 223333 - PLUMBING EQUIPMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES
A. Water heaters.
B. Electric drinking fountains.

1.2 RELATED SECTIONS
A. Section 230529 – Supports, Anchors and Seals.
B. Section 230548 – Vibration Isolation.

1.3 REFERENCES
B. ASME Section VIIID – Pressure Vessels; Boiler and Pressure Vessel Codes.

1.4 SUBMITTALS
A. Submit under provision of Uniform General Conditions & Special Conditions.
B. Product Data:
   1. Include dimension drawings of water heaters and heat exchangers indicating components and connections to other equipment and piping.
   2. Provide electrical characteristics and connection requirements.

1.5 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Uniform General Conditions & Special Conditions.
B. Include operation, maintenance, and inspection data, replacement part numbers and availability and service depot location and telephone number.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with local, county, state and national laws, codes and ordinances.
B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
6. Underwriters Laboratories (UL).

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery, store, protect and handle products to/at site under provisions of Uniform General Conditions & Special Conditions.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 – PRODUCTS

2.1 WATER HEATERS (EWH-1 AND EWH-2)

A. Manufacturer: Water heater (EWH-1) shall be as scheduled on the drawings and manufactured by Stiebel Eltron. Equivalent products by other manufacturers, which will fit in the available space, will be considered.

B. Manufacturer: Water heater (EWH-3) shall be as scheduled on the drawings and manufactured by A. O. Smith. Equivalent products by other manufacturers, which will fit in the available space, will be considered.

2.2 ELECTRIC DRINKING FOUNTAIN (EDF-1)

A. Manufacturer: Electric drinking fountain (EDF-1) shall be as scheduled on the drawings and manufactured by Elkay. Equivalent products by other manufacturers, which will fit in the available space, will be considered.

PART 3 – EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer’s instructions. Furnish and install ASME rated pressure and temperature relief valves and vacuum relief valve.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

C. Pipe relief valves and drains to floor drain.

D. Provide all hangers and supports required for tank installation.
E. Install thermometer well, furnished under another Section of these specification for monitoring hot water supply temperature.

F. Flush water heater upon completion of installation in accordance with manufacturer's instructions.

G. Start-up water heater in accordance with manufacturer's written procedures, upon completion of heater installation, and demonstrate compliance with requirements.

END OF SECTION 223333
SECTION 224000 - PLUMBING FIXTURES AND TRIM

PART 1 – GENERAL

1.1 SECTION INCLUDES
   A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Mechanical and Plumbing Work, and General Requirements (if any), apply to the work specified in this section.

1.2 GENERAL REQUIREMENTS
   A. Install plumbing fixtures and trim as required to make a complete and working plumbing system(s) for the building.

1.3 QUALITY ASSURANCE
   A. Manufacturers: Firms regularly engaged in the manufacture of plumbing fixtures and trim, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
   B. Installer: A firm with at least three (3) years of successful installation experience on projects with plumbing fixtures and trim work similar to that required for project.
   C. Acceptable Manufacturers: AMERICAN STANDARD, KOHLER, CRANE, TOTO, WHITEHALL, ELKAY or approved.

1.4 JOB CONDITIONS
   A. Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

PART 2 - PRODUCTS - SEE FIXTURE SCHEDULE ON DRAWINGS

2.1 PLUMBING FIXTURES
   A. General: Provide factory-fabricated fixtures of the type, style and material indicated. All fixtures are to be salt-water and corrosion resistant. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type is indicated, selection is Texas Parks and Wildlife Department (TPWD) Construction Manager's option.

   Where type is not otherwise indicated, provide fixtures complying with governing regulations.
   B. Provide approved plumbing fittings. Visible parts of fixture brass and accessories shall have heavy chrome plating.
C. Fixtures shall be products of one manufacturer. Fittings of same type shall be product of one manufacturer.

D. Protect fixtures against use and damage during construction.

2.2 PLUMBING FITTINGS, TRIM AND ACCESSORIES

A. Vacuum Barriers: Provide with flush valves where required by governing regulations.

B. P-Traps: Include removable P-traps where drains are indicated for direct connection to drainage system.

C. Carriers: Provide cast-iron supports for fixtures of graphitic gray iron, ductile iron, or malleable iron as indicated.

D. Fixture Bolt Caps: Provide manufacturer’s standard exposed fixture bolt caps finished to match fixture finish.

E. Provide wall straps below all lavatory and sinks.

F. Provide insulation for all exposed pipe below lavatories and sinks for ADA requirement.

PART 3 – EXECUTION

3.1 INSPECTION AND PREPARATION

A. Installer of plumbing fixtures must examine rough-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished.

B. Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer’s written instructions, rough-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the Uniform Plumbing Code pertaining to installation of plumbing fixtures.

3.2 INSTALLATION

A. Install each fixture with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.

B. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers and escutcheons.

C. Install wall mounted lavatories, urinals and water closets with approved wall carriers, model to suit installation.

D. Mount fixtures above finished floor as indicated on the Architectural drawings.

E. Protect installed fixtures from damage during the remainder of the construction period.
F. Provide above ceiling shut offs if necessary to isolate individual unit for replacement.

G. Provide either screw-stops for shown valves or stainless steel access panel so that valve seat replacement can be done without draining the building system.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Inspect each installed unit for damage. Remove cracked, chipped or dented units and replace with new units.

END OF SECTION 224000
SECTION 230000 - MECHANICAL BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for providing basic mechanical and plumbing materials.

B. This section of the work shall include all materials, equipment, qualified labor, and the tools required to make the installations, all as described herein and as shown on the accompanying drawings, to result in complete systems in working order. Items of work on appurtenant accessories which are not specifically mentioned herein or indicated on the drawings, but which are obviously or normally required for proper execution of the work shall be furnished and installed as required.

1.2 STANDARDS

A. The Contractor shall comply with all Municipal, State, County, and Federal laws, ordinances, rules and regulations governing or relating to building and construction, employment standards, and public health and safety, where applicable.

All Mechanical work shall conform to the requirements of the latest editions and applicable sections of the following codes and standards.

1. ANSI: American National Standard Institute
2. AWS: American Welding Society
3. OSHA: Occupational Safety and Health Administration
4. NFC: National Fire Codes
5. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
6. SMACNA: Sheet Metal and Air Conditioning Contractors National Association
7. ASME: American Society of Mechanical Engineers
8. NEMA: National Electrical Manufacturers Association
9. UL: Underwriters Laboratories, Inc.
11. AMCA: Air Movement and Control Association
12. FM: Factory Mutual
13. ARI: Air Conditioning & Refrigeration Institute
14. MSS: Manufacturing Standardization Society of the Valve and Fittings Industry
15. ASTM: American Society for Testing and Materials
17. 2012 Uniform Plumbing Code
18. 2012 Uniform Mechanical Code
19. 2017 National Electrical Code

1.3 QUALITY ASSURANCE

A. The Specifications and accompanying Drawings are intended to encompass a system that will not interfere with the structural, electrical and architectural design of the building, and which will fit into the space provided. As it is not within the scope of the Drawings to show all necessary offsets and obstructions, it shall be the responsibility of the Contractor to install his work in such a manner that
it will conform to the structure, avoid obstructions and interferences, preserve headroom, and keep openings and passageways clear.

B. Provide all materials, components, and services in accordance with a quality control program that assures compliance with the applicable codes, standards, and this specification.

1.4 WORKMANSHIP

A. Labor shall be performed in a workmanlike manner by mechanics skilled in their particular trade. Pipe and equipment shall be installed square and plumb accessible for proper operation and service. Installation shall be consistent in completeness and appearance whether concealed or exposed.

B. All work shall be performed by, or under the direct supervision of a supervisor licensed by the State of Texas, Texas Department of Licensing and Registration (TDLR). Contractor shall provide written proof of licenses to Texas Parks and Wildlife Department Construction Manager for Owner approval prior to starting work.

1.5 SUBMITTALS

A. Submittals shall be presented according to the terms of the contract and as specified in Uniform General Conditions & Special Conditions. Item submitted shall be clearly marked on submittal sheet; all non-applicable data shall be crossed out.

B. Specific items to be submitted:

1. Submittals are required for the items listed in Part 2 - Products.
2. The following are required for each size and/or type of item identified.
   a. Descriptive Literature
   b. Dimensional Drawings
   c. Manufacturer's Data Sheets

1.6 ADJUSTING, BALANCING, AND TESTING

A. After completion of the installation, regulate, adjust and test all equipment and devices. Final testing and balancing shall be done by a certified testing and balancing company.

B. HVAC Equipment shall be adjusted, balanced and tested per Section 230593 and report submitted to engineer and Owner prior to Substantial Completion.

1.7 PRODUCT DELIVERY AND HANDLING

A. Materials shall be delivered in the manufacturer's original unopened packaging, labeled to indicate the manufacturer's name and product identification.

B. Delivered materials shall be handled to ensure that the packaging and labeling remain intact until installation of material. Materials shall be stored and protected from ground contact and from the elements.
PART 2 – PRODUCTS

2.1 INSULATING (DIELECTRIC) PIPE JOINTS

A. Insulating Joint Resistance: Not less than 1 megohm.

B. Insulating Joint Types: Insulating union, insulating coupling, or insulating flange, as indicated, or as required by the characteristics of the piping system. Install at all connections of dis-similar metals.

Insulating joint materials to be installed underground shall be able to withstand the coating application, temperature and the environment at the Work site.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General

1. Installations shall be consistent in completeness and appearance whether enclosed or exposed.
2. Follow manufacturer’s approved written directions for assembling, erecting, installing, lubricating, and cleaning manufactured equipment and materials.
3. Cut materials accurately to measurements established at Work site; install without springing or forcing.
4. Do not weaken structural portions of buildings or structures.
5. Make final connections to all equipment.
6. Install counterflashing.
7. Make allowance for expansion and contraction by use of swing joints, loops, or changes in direction.
8. Provide sleeves and inserts; coordinate location of sleeves, inserts, openings, and under floor lines in ample time to avoid cutting new construction.

B. Ductwork

1. Install ductwork parallel with lines of building unless otherwise indicated.
2. Make changes in size and direction with fittings.

3.2 OPENING, CUTTING AND PATCHING

A. Openings

Major openings required for ductwork shall be provided with due care and consideration for the work of other trades and for the appearance and integrity of the building.

B. Location

The Contractor shall, at a time in advance of the Work, verify the openings as shown on the Architectural Drawings.
C. Cutting and Patching

Any additional cutting, patching and reinforcement of construction shall be subject to approval by the Texas Parks and Wildlife Department (TPWD) Construction Manager.

END OF SECTION 230000
SECTION 230529 - SUPPORTS, ANCHORS AND SEALS

PART 1 – GENERAL

1.1 GENERAL
A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Mechanical and Plumbing Work and General Requirements (if any), apply to the work specified in this section.

1.2 WORK INCLUDED
A. Pipe hangers and supports.
B. Duct hangers and supports.
C. Flashing for mechanical equipment.
D. Sleeking for mechanical equipment.

1.3 REFERENCE STANDARDS
A. Pipe supports shall meet the requirements of ANSI B31.1.
B. Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

1.4 QUALITY ASSURANCE
A. Manufacturers: Firms regularly engaged in the manufacture of hangers, supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

1.5 GENERAL REQUIREMENTS
A. Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction.
B. Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
C. Select hangers and supports for the service and in accordance with the manufacturer’s recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
D. Fasten hangers and supports to building steel. Do not support pipes, conduits, ducts, etc., from other pipes etc.
E. Provide and set sleeves required for equipment, including openings required for placing equipment.

4.3.2020 Supports, Anchors and Seals 100% Construction Documents 230529 - 1
PART 2 – PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS
   A. Hangers: Pipe sizes 1/2 inch to 1-1/2 inch: Adjustable wrought steel ring.
   B. Hangers: Pipe sizes 2 inches to 4 inches and Cold Pipe Sizes 6 inches and over, adjustable wrought steel clevis.
   C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   D. Wall Support: Pipe sizes to 3 inches, cast iron hook.
   E. Vertical Support: Steel riser clamp.
   F. Floor Support: Pipe sizes to 4 inches and all cold pipe sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
   G. Design hangers to impede disengagement by movement of supported pipe.
   H. Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping.

2.2 DUCT HANGERS AND SUPPORTS
   A. Hangers: Galvanized steel band, iron or rolled angle, and 3/8 inch rods.
   B. Wall Supports: Galvanized steel band, iron or fabricated angle bracket.
   C. Vertical Support at Floor: Rolled angle.

2.3 FLASHING
   A. Steel Flashing: 26 gage copper.
   B. Lead Flashing: 5 lb/sq.ft. sheet lead for water proofing, 1 lb/sq.ft. sheet lead for soundproofing.
   C. Safes: 5 lb/sq.ft. sheet lead or 8 mil thick neoprene.
   D. Caps: Steel, 22 gage minimum, 16 gauge at fire resistance structures.

2.4 SLEEVES
   A. Pipes through Floors: Form with 18 gage galvanized steel.
   B. Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or 18 gage galvanized steel.
   C. Round Ducts: Form with galvanized steel.
   D. Rectangular Ducts: Form with galvanized steel.
E. Size large enough to allow for movement due to expansion and to provide for continuous insulation.

F. Plastic Sleeves: May be used, in lieu of steel, where applicable so long as prior approval is obtained.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. Support horizontal steel and copper piping as follows:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Distance Between Support (Ft.)</th>
<th>Hanger Rod Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 to 1-1/2</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>2 to 5</td>
<td>8</td>
<td>3/8</td>
</tr>
</tbody>
</table>

Support horizontal cast iron piping as follows:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Distance Between Support (Ft.)</th>
<th>Hanger Rod Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>all sizes</td>
<td>20</td>
<td>3/8</td>
</tr>
</tbody>
</table>

B. Install hangers to provide minimum 1/2 inch clear space between finished covering and adjacent work.

C. Place a hanger within one foot of each horizontal elbow.

D. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.

E. When supporting insulated, pipe provide galvanized sheet metal saddle between hanger and pipe insulation. Paint saddle to match color of pipe insulation.

F. Support horizontal soil pipe near each hub, with 5 feet maximum spacing between hangers.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Where practical, support riser piping independently of connected horizontal piping.

3.2 LOW VELOCITY DUCT HANGERS AND SUPPORTS

A. Hanger Minimum Sizes:

1. Up to 30 inches wide: 1 inch x 16 ga. at 10 feet spacing.
2. 31 inches to 48 inches wide: 1-1/2 inches x 16 ga. at 10 feet spacing.
3. Over 48 inches wide: 1-1/2 inches x 16 ga. at 8 feet spacing.
B. Horizontal Duct on Wall Supports - Minimum Sizes
   1. Up to 18 inches wide: 1-1/2 inches x 16 ga. or 1 inch x 1 inch x 1/8 inch at 8 feet spacing.
   2. 19 inches to 48 inches wide: 1-1/2 inches x 1-1/2 inches x 1/8 inches at 4 feet spacing.

C. Vertical Duct Floor Supports - Minimum Sizes:
   1. Riveted or screwed to duct.
   2. Up to 60 inches wide: 1-1/2 inches x 1-1/2 inches x 1/8 inches.
   3. Over 60 inches wide: 2 inches x 2 inches x 1/8 inches.

3.3 EQUIPMENT SUPPORTS
A. Provide for major equipment reinforced concrete housekeeping pads poured directly on structural floor slab 4 inches thick minimum, extended 4 inches minimum beyond machinery bedplates, unless noted otherwise. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.

B. Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

C. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

3.4 PRIMING
A. Prime coat exposed steel hangers and supports. Hangers and supports located in pipe shafts and suspended ceiling spaces are not considered exposed.

3.5 FLASHING
A. Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inch minimum above finished roof surfaces with lead work 1 inch minimum into hub, 8 inch minimum clear on sides with minimum 24 inch x 24 inch sheet size. For pipes through outside walls turn flange back into wall and caulk.

C. Provide curbs for mechanical roof installations 14 inch minimum high. Flash and counterflash with copper, soldered and made waterproofed.

D. Provide and set sleeves required for equipment, including openings required for placing equipment.

3.6 SLEEVES
A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.
C. Where piping or ductwork passes through floor, ceiling or wall, close off space between pipe or duct and construction with noncombustible insulation. Provide tight fitting metal caps on both sides and caulk.

D. Install chrome plated escutcheons where piping passes through finished surfaces. Escutcheons required on both sides of wall.

END OF SECTION 230529
SECTION 230548 - VIBRATION ISOLATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for vibration isolators for rotating and reciprocating equipment and connected piping/ductwork.

B. Provide vibration isolation supports for equipment, piping and ductwork to prevent transmission of vibration to building structure.

1.2 QUALITY ASSURANCE

A. Expected noise levels in various parts of building shall comply with noise criteria recommendations as set forth in latest edition of the ASHRAE Systems Handbook and OSHA Standards; midpoint of range of NC criteria curves shall apply.

B. Select and install vibration isolators to prevent transmission of vibration which would cause noise levels in excess of noise criteria.

C. Vibration isolation manufacturer's representative shall consult and refer to equipment installation recommendations as necessary, to ensure correct installation and adjustment of isolators.

1.3 REFERENCE STANDARDS: Mechanical equipment when installed shall generate less vibration than the maximum allowable as listed in ASHRAE Systems Handbook, latest edition, Equipment Vibration Criteria section in the "Sound and Vibration Control."

1.4 SUBMITTALS

A. Submittals shall be presented according to the terms of the Contract and as specified in Uniform General Conditions & Special Conditions.

B. Specific items to be submitted:

1. Shop drawings to indicate the following:
   a. Type, size and deflection of each isolator proposed.
   b. Detail drawings of steel bases and concrete inertia bases.
   c. Outlined procedures for installing and adjusting isolators.
   d. Other information required to prove compliance with specifications.

2. The isolation supplier's submittal shall clearly show size, loading and location of all pipe isolation supports with either plan or complete description.

1.5 VIBRATION ISOLATION - AIR MOVING EQUIPMENT: Vibration isolation shall be selected to provide 95 percent efficiency. Select isolator deflection so the isolator natural frequency is 40% or
less than the fan speed. Spring isolators shall be accurately selected and furnished by air moving equipment manufacturer.

A. Air Handling Unit shall have the blower assembly internally isolated. In addition to the blower assembly isolators as described in Section 2.2C (Vibration Isolator Pad) shall be provided for each air handling unit.

B. In line or ceiling suspended exhaust fans shall be provided with isolators as described in Section 2.2B (Spring Hanger).

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in sealed manufacturer’s containers, appropriately packaged and crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including containers contained within others, on outside with item description(s) per title, Mark Numbers, and this Section number.

1.7 LABELING: Manufacturer shall securely attach in a prominent location on each major item of equipment a 316 Stainless Steel nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Amber-Booth

B. Korfund

C. Mason Industries

D. Kinematics

2.2 ISOLATORS

A. Vibration Isolators - Springs: Provide an adjustable, free-standing, stable, open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring (or springs) shall be welded or otherwise rigidly attached to mounting baseplate and to the spring compression plate. A neoprene pad having a minimum thickness of 1/4 in. shall be bonded to the baseplate. Baseplates shall be sized to limit pad loading to 100 psi.

B. Spring Hanger: Provide a spring hanger consisting of a rectangular steel box, coil spring, spring cups, neoprene impregnated fabric washer, and steel washer with the addition of an elastomeric element at the top of the box for acoustic isolation, and the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation. The spring shall provide the scheduled static deflection. The hanger box shall be capable of supporting 2 times rated load without noticeable deformation or failure.
The design shall be such as to prevent metal-to-metal contact between the hanger rod and the top of the hanger box.

C. Vibration Isolator Pad: The isolator shall consist of neoprene and cork with a total thickness of approximately 1 inch. Approximately 1/4 inch neoprene shall be permanently bonded to each side of 1/2 inch high density granulated cork. The neoprene shall have raised ribs to increase deflection and prevent slippage. The isolator shall be sized to provide an installed loading of between 15 psi and 40 psi. Where required to properly distribute load on isolator, a steel bearing plate shall be bonded to the top of the isolator.

2.3 CORROSION PROTECTION

A. Design and treat vibration isolators for resistance to corrosion.

B. Steel Components: Factory PVC coat.

C. Nuts, Bolts, and Washers: Zinc-electroplate.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer’s recommendations and shop drawings.

B. Install hangers for horizontal piping at regular intervals according to hanger schedule specified in Section 230553, Mechanical Identification.

C. Install temporary anchors for piping isolation supports, where required, to permit pre-adjustment of springs in risers.

END OF SECTION 230548
SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Pipe Markers.

1.2 REFERENCES:


1.3 SUBMITTALS:

A. Submit under provisions of Uniform General Requirements.
B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
D. Product Data: Provide manufacturer’s Installation Instructions: Indicate special procedures, and installation.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Uniform General Requirements.
B. Record actual locations of tagged valves.

PART 2 – PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
   1. Seton Setonply
   2. Other acceptable manufacturers offering equivalent products.
      a. Bunting Flexplate.

B. Description: Laminated three-layer plastic with engraved white letters on black background, beveled edges, each plate drilled with two (2) 3/8” mounting holes.
2.2 TAGS

A. Manufacturers:
   1. Seton.
   2. Other acceptable manufacturers offering equivalent products.
      a. Bunting.

B. Metal Tags: Brass with stamped letters; tag size minimum 1½ inch diameter with smooth edges.

C. Chart: Typewritten letter size list in anodized aluminum frame.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plastic nameplates with 3/8" No. 3 machine screws or 3/8" No. 4 sheet metal screws.

B. Install tags with No. 16 brass chain and brass "S" hook.

C. Identify air conditioning units and fans with plastic nameplates. Small devices may be identified with tags.

D. Identify control panels and major control components outside panels with plastic nameplates.

END OF SECTION 230553
SECTION 230593 - TESTING, ADJUSTING AND BALANCING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for testing, adjusting and balancing of the air distribution systems.

1.2 SCOPE

A. Work specified in this Section shall be the responsibility of an independent testing and balancing firm fully certified as a member of the Associated Air Balance Council (AABC) and is not part of the installing contractor.

B. Submit final data to the Texas Parks and Wildlife Department (TPWD) Construction Manager for approval.

1.3 QUALITY ASSURANCE

A. Submittals shall be presented according to the terms of the contract and as specified in Uniform General Conditions & Special Conditions.

B. Specific items to be submitted:

1. The report shall include (as a minimum) diagrams of the duct systems indicating each outlet, zone, fan, coil, and air handling unit. Performance data for the system's components shall be measured and recorded in accordance with AABC Procedural Standards and submitted on their standard forms. The following AABC Forms are representative of the scope of the measurement data:

   b. Certification: Same as above.
   c. Air Moving Equipment: AABC Form No. 12766, Air Moving Equipment Test Sheet.
   d. Zones: AABC Form No. 13068, Duct Traverse Readings and Form No. 12968, Zone Totals.
   e. Air Outlets: AABC Form No. 12666, Diffuser & Grille Test Sheet.
   f. Exhaust Fan: AABC Form No. 12866, Exhaust Fan Test Sheet.

2. Each individual Final Reporting Form submitted shall bear the signature of the person who recorded the data, the signature of the Balancing Crew Supervisor, and shall be certified by a registered P.E. in the State of Texas.

3. Work and submittals shall be performed in accordance with AABC, ASHRAE, SMACNA standards.

4. Identification of all types of test instruments used and their last dates of calibration to recognized standard shall be submitted with the final report.
PART 3 – EXECUTION

3.1 GENERAL

A. The distribution systems shall be tested, balanced and adjusted in accordance with the AABC National Standards for Field Measurements and Instrumentation and Total System Balance published by AABC (Latest Edition).

B. All work performed under this Section shall be under the direction of the supervisor acceptable to the Owner.

C. All instruments used for measurements shall be accurate, and calibration histories for each instrument shall be available for examination.

D. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC.

E. Accuracy of measurements shall be in accordance with AABC Standards.

F. The Preliminary Procedures as stated in AABC Standards shall be accomplished before actual balancing work begins on all air systems. All ductwork systems shall be checked in accordance with AABC Balance Requirements.

After completion of the above, the following TBA procedures shall be used as the basic guide in accomplishing the balance work:

1. Air Distribution Systems
   Test and Balance Procedures for all air systems:
   Supply Systems
   Return Systems
   Exhaust Systems

G. For variable air conditioning unit, main and branch ducts serving more than three (3) outlets shall be traversed with a pitot tube to verify total flow. The measurement point shall be indicated on the balancing diagrams and subsequent instrument readings submitted in the report.

H. Penetrations into ductwork shall be plugged with metal or plastic snap-in plugs. Penetrations through exterior insulation shall be repaired with insulation tape and marked by a red indicator, 2 inches square.

I. Opposed blade dampers, splitter dampers, and butterfly dampers shall be securely locked in place by quadrant lock, and the balance operator position marked with a permanent black ink for future reference.

J. Resetting of control devices in order to accomplish the balancing shall be performed in coordination with the Controls Contractor.
K. Outside air dampers and control valves shall be operated through the full range to verify smooth movement without binding or jumping, and proper linkage alignment free of interference from sheetmetal bracing, fasteners and insulation.

L. Air outlets shall be balanced to within 10 percent of the air quantities shown on approved drawings.

3.2 DUCTWORK LEAK TESTING
A. All supply round ductwork shall be leak tested in accordance with SMACNA standards.

3.3 NOTIFICATION
A. During the balancing, testing, and adjusting work specified herein, the Contractor shall notify the authorized representative in writing if the recorded system performance appears to be abnormally inadequate or otherwise not in conformance with the intended design conditions or quantities. The authorized representative, within a reasonable time, will issue instructions for corrective measures to be made by the Contractor. The corrective work shall be made and completed prior to final inspection.

3.4 TESTING
A. All tests, settings and flows be within the accuracies as stated in the Associated Air Balance Council standards. The Contractor shall provide a technician and instrumentation as necessary to demonstrate to the Owner the flow performance of any segment of any system as required at the time of final inspection. All readjustments and rework resulting from previous improper flow adjustment shall be made by the Contractor at no additional expense to the Owner.

END OF SECTION 230593
SECTION 230713 - DUCTWORK INSULATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.

B. Duct Liner. (May only be used under specific conditions and when specifically approved by TPWD)

C. Insulation Jackets.

1.2 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.


C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

E. ASTM E84 - Surface Burning Characteristics of Building Materials.


H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

I. UL 723 - Surface Burning Characteristics of Building Materials.

J. NFPA 90A.

1.3 SUBMITTALS

A. Submit under provisions of Uniform General Conditions & Special Conditions.

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Manufacturer’s Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.
1.4 QUALITY ASSURANCE
   A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 or UL 723.

1.5 QUALIFICATIONS
   A. Applicator: Company specializing in performing the work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE AND HANDLING
   A. Deliver, store and protect, and handle products to site under provisions of Uniform General Requirements.
   B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
   C. Store insulation in original wrapping and protect from weather and construction traffic.
   D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS
   A. Maintain ambient temperatures and conditions required by manufacturers of adhesive, mastics, and insulation cements.
   B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 – PRODUCTS

2.1 GLASS FIBER DUCT INSULATION, BOARD TYPE
   A. Manufacturers:
      1. Owens Corning.
      2. Other acceptable manufacturers offering equivalent products:
         a. Certain Teed Manson.
         b. Manville.
         c. Knauf.
         d. E.O. Woods.

   B. Insulation: ASTM C553; flexible, noncombustible rigid type.
      1. 'K' value: ASM C518, 0.23 at 75 degrees F.
      2. Maximum Service Temperature: 250 degrees F.
      3. Density: 3.0 lb/cu ft.
      4. ASJ, white faced vapor barrier.
C. Adhesive.
   1. Manufacturers:
      a. Kingco.
      b. Foster Products Company (H.B. Fuller Co.)
      c. 3M.
   2. Waterproof fire-retardant type, nonflammable.
   3. Fasteners: Galvanized steel, welded with integral head.

2.2 GLASS FIBER DUCT INSULATION, BLANKET TYPE
A. As described for board type insulation except:
   1. 1.5 lb density.
   2. K=0.25.

PART 3 – EXECUTION

3.1 EXAMINATION
A. Verify that ductwork has been tested before applying insulation materials.
B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION
A. Install materials in accordance with manufacturer’s instructions.
B. Insulate ductwork conveying air below ambient temperature:

3.3 DUCT LINER APPLICATION:
A. Adhere insulation with adhesive for 100 percent coverage.
B. Secure insulation with mechanical liner fasteners where recommended by the liner manufacturer. Refer to SMACNA Standards for spacing.
C. Seal and smooth joints.
D. Seal liner surface penetrations with adhesive.
E. Duct dimensions indicated are sheet metal dimensions.

3.4 BOARD TYPE DUCT INSULATION APPLICATION:
A. Wrap insulation tightly onto the ductwork with circumferential joints butted and longitudinal joints overlapped a minimum of 2 inches.
B. Adhere insulation to metal with 4 inch strips of insulation bonding adhesive at 8 inches o.c. on circumferential joints.

C. Secure the 2-inch flange of the facing with 9/16 flare-door staples applied 6 inches o.c.

D. Provide Foster No. 30-35 fire resistive mastic reinforced with 3 inch wide glass fabric to provide a positive vapor seal.

E. Insulation facing and adhesive shall meet requirements of NFPA 90A.

F. Apply 6 inch wide strip of insulation over duct reinforcement and standing seams, secured with mechanical fasteners.

G. Stop and point insulation with mastic and fabric at all access panels and damper operators to allow operations without disturbing insulation.

H. Provide duct test wells at all locations required for testing, adjusting balancing, and temperature measuring.

I. Repair perforations, tears and other penetrations of the vapor barrier with mastic and fabric.

3.5 BLANKET TYPE DUCT INSTALLATION APPLICATION:

A. Wrap tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2”.

B. Adhere insulation to metal with 4” strips of insulation bonding adhesive at 8” on center.

C. On circumferential and longitudinal joints, secure the 2” flange of the facing using 9/16” flare-door staples applied 6” on center and taped with 4” wide fiberglass tape embedded in Foster 30-35 white vapor barrier emulsion and covered with Foster 30-35 white vapor barrier until the tape is completely covered.

D. Repair pin penetrations or punctures in facing using tape.

3.6 TOLERANCE

A. Substituted insulation materials: Thermal resistance within 10 percent at specified conditions.

3.7 DUCT INSULATION REQUIREMENTS:

A. Pretreated outside air, supply and return air ducts for conditioned air located in unconditioned spaces must be insulated with a minimum of R-5.

B. Pretreated outside air, supply and return air ducts and plenums must be insulated to a minimum of R-8 when located outside the building envelope.
C. Provide external insulation for all pretreated outside air, supply, return and outside air ductwork, unless noted, as follows:

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<thead>
<tr>
<th></th>
<th>Within Mechanical Rooms</th>
<th>Concealed Above Ceiling</th>
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<tbody>
<tr>
<td>1. Round Ducts</td>
<td>Board Type</td>
<td>Blanket Type</td>
</tr>
<tr>
<td>2. Rectangular Ducts</td>
<td>Board Type</td>
<td>Blanket Type</td>
</tr>
<tr>
<td>3. Outside Air Plenum</td>
<td>Board Type</td>
<td>Blanket Type</td>
</tr>
<tr>
<td>4. Outside Air/Make Up Air</td>
<td>Board Type</td>
<td>Blanket Type</td>
</tr>
</tbody>
</table>

D. Ductwork requiring liner.

1. Exhaust duct 5' from inlet.

END OF SECTION 230713
SECTION 230716 - INSULATION OF MECHANICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION
A. This Section specifies the requirements for thermal insulation of piping, duct and equipment.

1.2 WORK
A. In general, piping or equipment subject to freezing shall be insulated. HVAC condensate drain piping and fittings shall be insulated.

B. Piping
1. Supply and install piping insulation as follows:
   a. For pipe diameters 2" or less: 1" thick
   b. For pipe diameters 2 1/2" or greater: 1 1/2" thick

2. Supply and install vapor barrier for the entire piping insulation system. Vapor barrier mastic shall be applied to form a vapor seal between pipe insulation jackets at butt joints, fittings, flanges and at 18 ft. intervals or fraction thereof.

3. Supply and install saddle inserts between each pipe saddle and vapor seal. Inserts shall be finished to match the pipe insulation finish.

4. Supply and install protection shields between insulation and piping supports. Shields shall be formed to fit insulation and shall extend up to center line of pipe. A coat of insulation coating shall be applied to insulation in contact with the protection shield.

C. Ductwork
1. For all areas, supply and install external insulation on ductwork.
2. Supply and install ductwork insulation as follows:
   a. External - 2" min., unless noted otherwise on the drawings.

D. Equipment
1. Provide and install insulation for the domestic hot water tanks, hot water pump and other heating system piping. Vessels shall be insulated with 1-1/2 inch thick temperature blanket insulation secured with wire mesh. A 1/4 inch thick coat of insulation and finishing cement shall be applied and troweled to a smooth surface. After cement has dried, fiberglass reinforcing mat and insulation coating shall be applied to a smooth finish.
1.3 QUALITY ASSURANCE

A. General Requirements

Installation shall comply with the applicable requirements of NFPA 90A and NFPA 90B.

B. Products shall be noncombustible as defined in NFPA 101 and must be asbestos free.

C. Products shall be UL listed and labeled as tested in accordance with UL 723.

D. Test shall demonstrated that products do not exceed the following ratings:

1. Flame-spread: No more than 25.
2. Smoke developed: No more that 50.

E. Flame spread and smoke developed ratings shall be determined as described in UL 723.

F. Materials that are factory applied shall be tested as assembled. Materials that are field applied shall be tested individually.

G. Materials used to impart flame resistance to the insulation materials shall be nonfungitive and noncorrosive.

H. Products, or their shipping cartons, shall bear a label indicating the flame-spread and smoke developed ratings.

I. Reference Standards Applicable to the Section

1. ASTM: American Society for Testing and Materials


2. NFPA: National Fire Protection Association

   b. 90B: Standard for the Installation for Warm Air Heating and Air Conditioning Systems.

3. UL: Underwriters Laboratories Inc.

   b. 181: Air Ducts, and Factory Made Connectors.
1.4 SUBMITTALS
   A. Submittals shall be presented according to the terms of the Contract and as specified in Uniform General Conditions & Special Conditions.
   B. Specific items to be submitted:
      1. Manufacturer's complete technical information including installation instructions and procedures.
      2. Samples of any product as requested by the Owner.

1.5 PRODUCT DELIVERY AND HANDLING
   A. Materials shall be delivered in the manufacturer's original unopened packaging, labeled to indicate the manufacturer's name and product identification.
   B. Delivered materials shall be handled to ensure that the packaging and labeling remain intact until installation of the material. Materials shall be stored and protected from ground contact and from the elements.

1.6 JOB CONDITIONS
   A. Environmental Requirements
      Materials shall be installed at temperatures and other environmental conditions recommended by the material manufacturer.

PART 2 – PRODUCTS

2.1 DUCTWORK INSULATION
   A. Low Temperature Blanket Insulation: Blanket-type fiberglass insulation with factory applied vapor barrier. Provide either All Service Faced Duct Wrap by Owens/Corning Fiberglas or Standard Duct Wrap by CertainTeed Corporation.
   B. Medium Temperature Blanket Insulation: Blanket-type fiberglass insulation. Provide either TIW, Type II by Owens/Coring Fiberglas or Type 850 Insulation by CertainTeed.
   C. Medium Density Rigid Insulation: Fiberglass insulation board with factory applied vapor barrier. Provide either Type 703 board with FRK-25 facing by Owens/Corning Fiberglas or Type IB 300 board with FSK facing by CertainTeed Corporation.
   D. High Density Rigid Insulation: Fiberglass insulation board with factory applied vapor barrier. Provide either Type 705 board with FRK-25 facing by Owens/Corning Fiberglas or Type IB 600 board with FSK facing by CertainTeed Corporation.
   E. High Temperature Block Insulation: Rigid Hydrous calcium silicate insulation. Provide either Kaylo 10 by Owens/Corning Fiberglas or Super Caltemp by Pabco Insulation Division, Louisiana-Pacific Corporation.
F. Elastomeric Insulation:

2.2 INSULATION ACCESSORIES
   A. Metal Jackets: Stainless with stainless bands and fasteners.
   B. Vapor Barrier Mastic: Provide either Type 30-35 by H B Fuller Company or Foster Products Division, Type CP-30A by Childers Products Company.
   C. Vapor Barrier Adhesive: Provide either Type 85-20 by H B Fuller Company, Foster Products Division or Type CP-50A by Childers Products Company.
   D. Insulation Coating: Provide either type 30-36 by H B Fuller Company, Foster Products Division or Type CP-50A by Childers Products Company.
   E. Insulation and Finishing Cement: Provide either No. 110 by Owens/Corning Fiberglas or No. 375 by Manville Corporation.
   F. Saddle Inserts: Provide Foamglass pipe insulation by Pittsburgh Corning.
   H. Protection Shields: Carbon steel sheet, galvanized, ASTM A 526 or A 527 with ASTM A 525, G 60 coatings. Dimensions as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Shield Gauge</th>
<th>Length of Shield</th>
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<tbody>
<tr>
<td>1/2 in. to 3 in.</td>
<td>20</td>
<td>12 in.</td>
</tr>
<tr>
<td>4 in. to 8 in.</td>
<td>12</td>
<td>16 in.</td>
</tr>
</tbody>
</table>
   I. Wire Mesh: Woven, 1 in. mesh, galvanized, No. 18 gauge wire.

PART 3 – EXECUTION

3.1 INSPECTION
   A. Piping, ductwork and equipment to be insulated shall be examined for defects that would be detrimental to the installation of the insulation.
   B. Do not proceed with the installation until all unsatisfactory conditions have been corrected and all tests have been satisfactorily completed.
3.2 GENERAL

A. Piping, ductwork and equipment shall be clean and dry before the insulation is applied.

B. Insulation and accessories shall be installed in accordance with the insulation and accessories manufacturer’s installation instructions.

C. Duct insulation shall be continuous over hangers and supports, through walls, partitions, floors and ceiling openings, except at fire dampers in duct systems.

D. Pipe insulation shall be continuous, except at pipe sleeves. Insulation ends at pipe sleeves shall be sealed with vapor barrier.

E. Pipe fittings, flanges, unions and valves shall be insulated with preformed fitting insulation.

F. Outdoor and tunnel piping insulation shall be covered with metal jackets installed with the longitudinal joint positioned to shed water, and with the circumferential joints overlapped a minimum of 2 inches.

G. Metal jackets shall be installed over the insulation of exposed indoor piping up to a minimum height 8 ft above finished floor and on all insulated fire protection and domestic water exposed to outdoor temperature.

H. Insulation shall be secured to duct bottoms and sides with mechanical fasteners on 18 inch centers and with vapor barrier adhesive applied to all sides of the ducts in 6 inch wide bands, 18 inch on centers.

I. Joints, fasteners penetrations, and other breaks in vapor barrier shall be sealed with either 3 inch wide strips of same duct facing materials adhered with vapor barrier adhesive or 3 inch wide strips of fiberglass reinforcing fabric coated with vapor barrier mastic.

END OF SECTION 230716
SECTION 230719 - PIPING INSULATION

PART 1 – GENERAL

1.1 SECTION INCLUDES
A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Mechanical and Plumbing Work, and General Requirements (if any), apply to the work specified in this section.

1.2 SUBMITTALS
A. Submit shop drawings and samples as specified in Uniform General Conditions & Special Conditions.
B. Submit shop drawings that indicate complete material data, a list of materials proposed for this project and indicate thickness of material for individual services.

1.3 QUALITY ASSURANCE
A. Manufacturers: Firms regularly engaged in the manufacture of piping and equipment insulation, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
B. Installer: A firm with at least three (3) years of successful installation experience on projects with piping and equipment insulation work similar to that required for project.

1.4 JOB CONDITIONS
A. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
B. Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.5 ALTERNATIVES
A. Alternative insulations are subject to Texas Parks and Wildlife Department (TPWD) Construction Manager approval. Alternatives shall provide the same thermal resistance within 10%, at normal conditions as materials specified.
PART 2 – PRODUCTS

2.1 GENERAL

A. Adhesives and Insulation Materials: Composite fire and smoke hazard ratings shall not exceed 25 for Flame Spread and 50 for Smoke Developed. Adhesives shall be waterproof.

2.2 MATERIALS AND COMPONENTS

A. Hot Piping: All domestic lines to include returns. Factory preformed fine fibrous glass insulation with factory applied general purpose jacket, molded to conform to piping, "K" value at 75 degree F. maximum 0.25 btu/in./sq.ft./deg.F./hr. Any exposed lines less than 84 inches above finished floor shall be covered with 0.016 inch aluminum pipe cover.

B. Cold Piping: All domestic lines to include returns. Factory preformed fine fibrous glass insulation with factory applied vapor barrier jacket, molded to conform to piping, "K" value at 75 degree F. maximum 0.24 btu/in./sq.ft./deg.F./hr. Any exposed lines less than 84 inches above finished floor shall be covered with 0.016 inch aluminum pipe cover.

C. Condensate Piping: Performed flexible unicellular, with factory applied vapor barrier jacket, molded to conform to piping, "K" value at 75 degree F. maximum 0.24 btu/in./sq.ft./deg.F./hr.

D. Roof Drains and Vents: Flexible fibrous glass insulation, "K" value at 75 degree F. maximum 0.26 btu/in./sq.ft./deg.F./hr. with factory applied reinforced aluminum foil vapor barrier.

E. Acceptable Manufacturers: CERTAINTEED CORP., SCHULER/JOHNS-MANVILLE CORP., KNAUF FIBER GLASS, OWENS-CORNING FIBERGLASS CORP., or approved.

PART 3 – EXECUTION

3.1 PREPARATION

A. Do not install covering before piping and equipment has been tested and approved.

B. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 INSTALLATION

A. Insulate supply and drain piping at lavatories with Lavgaurd or Lavshield as manufactured by Truebro to comply with ADA.

B. Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.
C. Insulate fittings and valves. Do not insulate unions, flanges, strainers, flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

D. Finish insulation neatly at hangers, supports and other protrusions.

E. Locate insulation or cover seams in least visible locations.

F. Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in pipe shafts and suspended ceiling spaces is not considered exposed. Use presized paper under recovering at uneven insulated surfaces.

G. Cover insulation exposed to outdoors with aluminum cover with aluminum bands on 8 inch centers. Lap joints 3 inches minimum and seal with compatible waterproof lap cement. Cover seams to face down.

H. Hot Piping: Cover fittings and valves with equivalent thickness of insulation material. For exposed fittings and valves apply hydraulic setting cement paste over insulating material before applying canvas recovering.

I. Cold Piping: Cover fittings and valves with equivalent thickness of insulation material. Cover with open mesh glass cloth sealed with vapor barrier sealant. Seal lap joints with 100% coverage of vapor barrier sealant and adhesive. Seal butt joints with 4 inch wide strips of vapor barrier sealed with vapor barrier adhesive. For exposed fittings and valves, apply hydraulic setting cement paste over insulation material before applying recovering.

J. Roof Drains and Vents: Adhere flexible insulation with adhesive applied in 6 inch wide strips on 16 inch centers. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 16 inch centers for securing insulation until adhesive sets. Butt insulation and seal joints and breaks with 2 inches of foil adhered over joint.

K. At each pipe or equipment support point, install a hard section of Foamglass for cold pipe, calcium silicate for hot pipe, minimum 8 inches in length, on lower 180 degrees of piping, 360 degrees if clamps are used on top of pipe, same thickness as adjacent insulation, to prevent compression at support bearing area. Seal and finish to match the adjoining insulation. Provide formed galvanized sheet metal saddles to completely cover the hard section.
### 3.3 INSULATION THICKNESS SCHEDULE

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Insulation Thickness (In.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Water Piping All Sizes Up to 2</td>
<td>1</td>
</tr>
<tr>
<td>Cold Water Piping Over 2</td>
<td>1</td>
</tr>
<tr>
<td>Hot Water Piping All Sizes Up to 1 1/2</td>
<td>1</td>
</tr>
<tr>
<td>Hot Water Piping Over 1 1/2</td>
<td>2</td>
</tr>
<tr>
<td>Roof Drains, Vertical Connection Between Drains and Horizontal Piping All Sizes Up to 2</td>
<td>1</td>
</tr>
<tr>
<td>Roof Drains, Vertical Connection Between Drains and Horizontal Piping Over 2</td>
<td>1</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>2</td>
</tr>
<tr>
<td>Vents within 6 lineal feet of Roof Outlet All Sizes Up to 1</td>
<td>1/2</td>
</tr>
<tr>
<td>Vents within 6 lineal feet of Roof Outlet Over 1</td>
<td>1</td>
</tr>
<tr>
<td>Refrigeration Piping (Both liquid and suction) All Sizes</td>
<td>1</td>
</tr>
</tbody>
</table>

**NOTE:**

Cold water piping and roof drain leaders: All piping in plenum space above the finish ceiling shall be insulated. Piping under the slab need not be insulated. All exterior piping shall be insulated per 2.2.A. and 3.2.F.

**END OF SECTION 230719**
SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes control sequences for HVAC systems, and equipment.

1.2 VARIABLE AIR CONDITIONING UNIT CONTROL SEQUENCES

A. Supply Fan(s) Variable-Volume Control:

1. Occupied Time Schedule:
   a. Input Device: Time clock or Direct Digital Control (DDC) system time schedule.
   b. Output Device: Time clock or Binary output.
   c. Action: Enable control.

2. Volume Control:
   a. Input Device: Static-pressure transmitter or Differential-pressure switch sensing supply-duct static pressure referenced to conditioned-space static pressure.
   b. Output Device: Receiver controller or DDC system analog output to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
   c. Action: Maintain constant supply-duct static pressure.

3. High Pressure:
   a. Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.
   b. Output Device: Receiver controller or DDC system binary output to alarm panel and motor starter.
   c. Action: Stop fan and signal alarm when static pressure rises above excessive-static-pressure set point.

4. Display:
   a. Supply-fan-discharge static-pressure indication.
   b. Supply-fan-discharge static-pressure set point.
   c. Supply-fan airflow rate.
   d. Supply-fan inlet vane position or speed.

B. Mixed-Air Control:

1. Occupied Time Schedule:
   a. Input Device: Time clock or DDC system time schedule.
   b. Output Device: DDC system output.
   c. Action: Enable control.
2. Minimum Position:
   a. Input Device: Time clock or DDC system time schedule.
   b. Output Device: Receiver controller or DDC system analog output to modulating damper actuator(s).
   c. Action: Open minimum outdoor-air dampers or outdoor-air dampers to minimum position.

3. Supply Mixed-Air Temperature:
   a. Input Device: Duct-mounted thermostat or Electronic temperature sensor.
   b. Output Device: Receiver controller or DDC system analog output to modulating damper actuator(s).
   c. Action: Modulate outdoor-air, return-air, and relief-air dampers to maintain air temperature set point of 55 deg F.

4. Cooling Reset:
   a. Input Device: Outdoor-air and return-air, duct-mounted thermostats or electronic temperature sensors.
   b. Output Device: Receiver controller or DDC system analog output to damper actuator(s).
   c. Action: Set outdoor-air dampers to minimum position when outdoor-air temperature exceeds return-air temperature or outdoor air enthalpy exceeds return-air enthalpy.

5. Unoccupied Time Schedule:
   a. Input Device: Time clock or DDC system time schedule.
   b. Output Device: Receiver controller or DDC system analog output to modulating damper actuator(s).
   c. Action: Position outdoor-air and relief-air dampers closed and return-air dampers open.

6. Display:
   b. Mixed-air-temperature set point.
   c. Mixed-air damper position.

1.3 VAV BOX OPERATING SEQUENCE

A. Heating Coils, Electric: Room thermostat sequences stages of heating.

B. VAV Box:

1. Occupied/Unoccupied:
   a. Input Device: Time clock or DDC system time schedule.
   b. Output Device: DDC system binary output.
   c. Action: Enable occupied/unoccupied temperature set points.

   1) Occupied Temperature: 75 deg F
   2) Unoccupied Temperature: 65 deg F.
2. Room Temperature:
   a. Input Device: Room thermostat or electronic temperature sensor.
   c. Action: Modulate damper to maintain temperature.

   1) Sequence when space temperature is below set point: Close VAV damper to minimum position, energize and stage electric heating strip to maintain the space temperature set point.
   2) Sequence when space temperature is above set point: De-energize the electric heating strip, modulate VAV damper to maintain the space temperature set point.

3. Display:
   a. Room/area served.
   b. Room occupied/unoccupied.
   c. Room temperature indication.
   d. Room temperature set point.
   e. Room temperature set point, occupied.
   f. Room temperature set point, unoccupied.
   g. VAV damper position as percent open.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - SEQUENCE OF OPERATION:

Variable Speed Air Conditioning Unit

1. The unit and VAV boxes served by it will have an occupied/unoccupied schedule that when occupied will activate the unit.

2. When the unit is activated, the DDC the AC fan system. A current switch will prove status to the DDC system and alarm the central site if the switch is not made within 20 seconds (adjustable). There will also be a 10 second (adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch.

3. A duct-mounted temperature sensor will monitor the supply air temperature. The DDC system will stage up cooling stages, in sequence, to maintain the supply air temperature setpoint of 55°F (adjustable) in cooling season.

4. The DDC system control module will receive an input from a static pressure sensor located two-thirds down the longest duct run. The DDC system will send a modulating signal to a variable speed drive, which will adjust the air volume of the AC unit fan to maintain the required pressure setpoint of 1” (adjustable). A manual reset high static limit switch located in the discharge of the AC unit will de-energize the AC unit if the static pressure exceeds 3.0” w.g. (locally adjustable).

5. When the unit is off, its fan and DX cooling will be off. During the unoccupied period, if the space temperature reaches the heating or cooling setpoints, the RTU will be started and run to maintain the space temperature within these setpoints: 55°F (adjustable) heating and 85°F (adjustable) cooling.

VAV Boxes

1. Each VAV Box will have occupied cooling/heating setpoints and unoccupied cooling/heating setpoints assigned to it. As the AC unit serving the box’soccupancy
time approaches, an optimum start/stop program will calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outdoor air temperature. All variables are operator assignable from the central site.

2. When the zone becomes occupied the VAV controller will determine, based on the space temperature, whether heating or cooling is required. If cooling is required, a P.I.D. control loop will modulate the VAV terminal’s setpoints from the minimum cooling CFM setpoint (adjustable) to its maximum cooling CFM setpoint (adjustable) as required to maintain the space temperature. As the space temperature returns to setpoint, the CFM setpoint will be modulated back to its minimum cooling setpoint. The VAV terminal controller will modulate the terminal damper to maintain the CFM setpoints. If heating is required, the VAV terminal damper will be maintained at its minimum heating (adjustable) CFM setpoint and the electric heat strips on the box will be staged as necessary to maintain the space temperature. If the space temperature is satisfied, the electric heat strip will be de-energized

3. During the unoccupied time period, the VAV terminal damper will be closed, and the electric heat will be off. If the space temperature reaches the unoccupied heating or cooling setpoints, the required equipment will be started and run to maintain the space temperature within these setpoints: 55°F (adjustable) heating and 85°F (adjustable) cooling

Exhaust Fans

1. Each exhaust fan shall run whenever the VAV box associated with the same space runs.

POINT LISTS:

**AC Unit**

- Fan Start/Stop
- Fan Status
- DX Cooling Output
- Discharge Air Temp
- Static Pressure
- High Static Pressure
- Freeze Stat
- Outdoor Air damper

**Vav Boxes**

- Damper
- Electric Heat Strips
- CFM Flow
- Zone Temp
- Discharge Air Temperature

**Miscellaneous Points**

- Outdoor Air Temperature
- Exhaust Fan Start/Stop

END OF SECTION 230993
SECTION 231126 - FACILITY LIQUEFIED-PETROLEUM GAS PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for propane gas piping systems.

1.2 RELATED REQUIREMENTS

A. Section 220719 - Plumbing Piping Insulation.

B. Section 230548 - Vibration Isolation.

C. Section 230553 – Mechanical Identification.

D. Section 312333 - Trenching and Backfilling.

1.3 REFERENCE STANDARDS


D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.


F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.


H. ASME B31.9 - Building Services Piping; 2014.


N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.


V. AWWA C606 - Grooved and Shouldered Joints; 2015.


X. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.


BB. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

CC. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.


1.4 SUBMITTALS

A. See Uniform General Conditions & Special Conditions, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.

D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
E. Project Record Documents: Record actual locations of valves.

F. Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.
   1. See Uniform General Conditions & Special Conditions, for additional provisions.

1.5 QUALITY ASSURANCE
   A. Perform work in accordance with applicable codes.
   B. Valves: Manufacturer’s name and pressure rating marked on valve body.
   C. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
   D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
   E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
   B. Provide temporary protective coating on cast iron and steel valves.
   C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
   D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS
   A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PROPANE GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING
   A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
      1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
   B. Polyethylene Pipe: ASTM D2513, SDR 11.
      1. Fittings: ASTM D2683 or ASTM D2513 socket type.
2.2 PROPAINE GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   2. Joints: NFPA 58, threaded or welded to ASME B31.1.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) annealed.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron.
   3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
   4. Gasket Material: Nitrile rubber suitable for operating temperature range from minus 20 degrees F to 180 degrees F.
   5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
   7. Manufacturers:
      a. Grinnell Products, a Tyco Business.
      b. Substitutions: See Uniform General Conditions & Special Conditions.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   a. Cold and Hot Pipe Sizes 6 Inches and Over: Double hangers.

3. Trapeze Hangers: Welded steel channel frames attached to structure.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.
   7. Manufacturers:
      a. Powers Fasteners, Inc.
      b. Substitutions: See Uniform General Conditions & Special Conditions.

2.5 BALL VALVES

A. Manufacturers:
   1. Conbraco Industries, Inc.
   2. Grinnell Products, a Tyco Business.
   4. Nibco, Inc.
   5. Uponor, Inc.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded or grooved ends with union.

2.6 STRAINERS

A. Manufacturers:
   3. WEAMCO.
   4. Substitutions: See Uniform General Conditions & Special Conditions.

B. Size 2 inch and Under:
   1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
   2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
C. Size 1-1/2 inch to 4 inch:
   1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

2.7 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Manufacturers:
   2. Dungs Combustion Controls.
   4. Substitutions: See Uniform General Conditions & Special Conditions.

B. Compliance Requirements:

C. Materials in Contact With Gas:
   1. Housing: Aluminum, steel (free of non-ferrous metals).
   2. Seals and Diaphragms: NBR-based rubber.

D. Maximum Inlet Operating Pressure: 10 psi.
   1. Appliance Regulator: 10 psi.
   2. Line Pressure Regulator: 10 psi.

E. Maximum Body Pressure: 10 psi.

F. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that 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.
   C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to equipment.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
   1. Refer to Section 220719.

F. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

G. Trench Backfilling in accordance with Section 312333.

H. Install valves with stems upright or horizontal, not inverted.

I. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.

J. Inserts:
   1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

K. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as indicated.
   3. Place hangers within 12 inches of each horizontal elbow.
   4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   8. Provide copper plated hangers and supports for copper piping.
   9. Prime coat exposed steel hangers and supports.

3.4 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate valves for shut-off and to isolate equipment or part of systems.

D. Install globe valves for throttling, bypass, or manual flow control services.
3.5 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

   a. Pipe Size: 1/2 inches to 1-1/4 inches:
      1) Maximum Hanger Spacing: 6.5 ft.
      2) Hanger Rod Diameter: 3/8 inches.

   b. Pipe size: 1-1/2 inches to 2 inches:
      1) Maximum Hanger Spacing: 10 ft.
      2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION 231126
SECTION 232000 - VALVES, COCKS AND FAUCETS

PART 1 – GENERAL

1.1 GENERAL

A. The general provisions of the Contract, including General and Special Conditions, the General Conditions for Mechanical and Plumbing Work and General Requirements (if any), apply to the work specified in this section.

1.2 WORK INCLUDED

A. Globe or angle valves.
B. Check valves.
C. Drain valves.
D. Valve connection.
E. Hose bibbs.
F. Plugs cocks.
G. Pressure ratings.
H. Gate valves.
I. Valve tags.

1.3 REFERENCE STANDARDS

A. American National Standards Institute, Inc.
B. American Society of Testing Materials.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of valves, cocks and faucets of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
B. Installer: A firm with at least three (3) years of successful installation experience on projects with valves, cocks and faucets work similar to that required for project.
C. Provide valves of same manufacturer throughout where possible.
D. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
E. Inspection of Castings: Provide valve bodies, bonnets and discs which have been inspected in accordance with manufacturer's standard written quality control procedure.

F. Acceptable Manufacturers: NIBCO, JENKINS, CRANE, STOCKHAM or approved equal.

1.5 SHOP DRAWINGS

A. Submit copies of valve "ordering schedule" for approval before ordering valves.

B. Submit detailed shop drawings in accordance with Uniform General Conditions & Special Conditions. Shop drawings shall clearly indicate make, model, location, type, size and pressure rating.

1.6 PRODUCT HANDLING

A. Provide manufacturers standard temporary protective coating on cast iron and steel valves, and provide factory-applied end-caps on valves. Maintain coating and end-caps through shipping, storage and handling, in adequate condition to inhibit corrosion, prevent damage and eliminate dirt and moisture from inside of valves. During transportation and delivery, handle valves with care using adequate lifting equipment. Do not drop or abuse valves. Store valves inside and protected from weather. Where coating has been removed or damaged, and where valves are in environment which could reasonably be expected to cause rusting, protect valves with separate, durable, waterproof wrapping.

PART 2 – PRODUCTS

2.1 GLOBE OR ANGLE VALVES

A. Bronze, rising stem, inside screw, renewable composition disc, solder or screwed ends.

B. Iron body, bronze trim, rising stem, renewable composition disc, flanged ends.

2.2 CHECK VALVES

A. Bronze, lift check, bronze disc, threaded ends.

B. Bronze swing check, bronze disc (cap & hinge), threaded ends.

2.3 DRAIN VALVES

A. Bronze compression stop with nipple and cap or hose thread.

2.4 VALVE CONNECTIONS

A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.

B. Thread pipe sizes 2 inches (51 mm) and smaller.
C. Flange pipe sizes 2-1/2 inches (63.5 mm) and larger.

D. Solder or screw to solder adapters for copper tubing.

E. Use grooved body valves with mechanical grooved jointed piping.

2.5 HOSE BIBBS

A. Bronze or red brass, replaceable hexagonal disc, hose thread spout, chrome plated where exposed unless indicated otherwise, see drawings.

2.6 PLUG COCK

A. Iron body, brass plugs and washers, air tested, solder or screwed ends.

B. Iron body and plug, pressure lubricated type, flanged ends.

2.7 PRESSURE RATINGS

A. Unless otherwise indicated, use valves suitable for minimum 125 psig WSP and 110 degree F. and 200 psig and 50 degree F.

B. Use valves for fire protection suitable for 175 psig WOG.

2.8 GATE VALVES

A. Bronze, rising stem, and screwed end.

B. Iron body, bronze trim, rising stem, O.S. & Y., renewable composition disc, flanged ends.

2.9 VALVE TAGS

A. Furnish valves with 1-1/2 inch diameter brass valve tag with stamped and red-filled numbers. Service designations shall be 1/4 inch letters, and valve numbers shall be 1/2 inch letters. Service designations shall be approved by Texas Parks and Wildlife Department (TPWD) Construction Manager. Secure tags to valves by use of brass "S" hooks and brass chain. Secure chain to valve by use of copper or monel meter seals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Except as otherwise indicated, comply with the following requirements:

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
2. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane unless unavoidable. Install valve drains with hose-end adaptor for each valve that must be installed with stem below horizontal plane or pointed down.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in the proper manner to receive insulation.

C. Applications Subject to Shock: Install valves with bodies of metal other than cast-iron where thermal or mechanical shock is indicated or can be expected to occur.

D. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless the bronze and steel are separated by a dielectric insulator. Install bronze valves in services where corrosion is indicated or can be expected to occur.

E. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:

   1. Tube Size 2” and Smaller: Solder-joint Valves.
   2. Pipe Size 2” and Smaller: Threaded Valves.
   3. Pipe Size 2-1/2” and Larger: Flanged Valves.

F. Valve: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS & Y valves.

G. Non-metallic Disc: Limit the selection and installation of valves with non-metallic discs to locations indicated and where foreign material in the piping system can be expected to prevent tight shut-off of metal seated valves.

H. Renewable Seats: Select and install valves with renewable seats, except where frequent usage of the valve is indicated.

I. Lubricant-Seal: Select and install plug valves with lubricant-seal except where frequent usage is indicated or can be reasonably expected to occur.

J. Fluid Control: Except as otherwise indicated, install gate, ball, globe, plug, and butterfly valves to comply with ANSI B31. Where throttling is indicated or recognized as the principal reason for the valve, install globe or butterfly valve. Install check valves where indicated and where flow reversal is obviously not desirable but can be reasonably expected to occur, including piping at the discharge of pumps. Install silent check valves where necessary to eliminate water hammer occurring from reversal of flow.

END OF SECTION 232000
SECTION 233100 – DUCTWORK

PART 1 – GENERAL

1.1 GENERAL

A. The general provisions of the Contract, including Uniform General Conditions and Special Conditions, the General Conditions for Mechanical and Plumbing Work, and General Requirements (if any), apply to the work specified in this section.

1.2 WORK INCLUDED

A. Ductwork and Plenums.
B. Fasteners.
C. Sealants.
D. Duct Cleaning.
E. Turning valves.
F. Volume control dampers.

1.3 REFERENCE STANDARDS

A. Ductwork fabrication and installation shall follow the recommendations of the SMACNA Duct Manuals.
   1. HVAC Duct Construction Standards - Metal and Flexible
   2. Fire Damper and Heat Stop Guide
B. ASHRAE Handbook of Equipment.
E. AMCA: Test Methods for Louvers and Dampers.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of ductwork, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer: A firm with at least three (3) years of successful installation experience on projects with ductwork work similar to that required for project. Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.
C. Ductwork shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems and NFPA No. 90B, Standard for the installation of Warm Air Heating and Air Conditioning Systems.

1.5 GENERAL REQUIREMENTS

A. The Engineering 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. The Contractor shall determine exact locations by checking the requirements of other trades, and by reviewing all Contract documents.

B. The Engineering Drawings indicate general routing of the various parts of the systems, and indicate all fittings, offsets, and runouts which are required for this duct layout. The work includes all fittings, offsets and runouts required to fit the system into spaces allotted to them. Any minor change in routing or duct size change to miss interferences shall be included by the Contractor.

C. Prior to the fabrication of any ductwork or the installation of any devices in the ceilings, the Contractor shall review all Shop Drawings with Texas Parks and Wildlife Department (TPWD) Construction Manager to ascertain that the locations of all devices in the ceilings will create a pattern which is compatible with the reflected ceiling plan and the spacings of the reflected ceiling plan and the spacings of the various ceiling mounted devices.

1.6 SUBMITTALS

A. Submit as specified in Uniform General Conditions & Special Conditions.

B. Submit with shop drawings for approval, including particulars such as gage sizes, welds and configurations prior to start of work.

1.7 ALTERNATIVES

A. Size round ducts installed in place of rectangular ducts indicated from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Galvanized Steel: All sheet metal duct work shall be prime low carbon, galvanized sheet steel complying with ASTM A 527, Lockforming Quality, with minimum galvanizing of 1-1/4 ounces per sq. ft. of ASTM A 525 G90 zinc coating, milling phosphatized, and with name of manufacturer and trade name stamped on each sheet.

1. Gages, Rectangular Ductwork: Fabricate steel ductwork (galvanized) from the following minimum gages for sizes up to the corresponding maximum long-side dimensions indicated:
   a. 24 gage up to 18" size.
   b. 22 gage up to 48" size.
   c. 20 gage up to 72" size.
   d. 18 gage for sizes larger than 72"
B. **Rigid Round or Oval Ductwork:** Round or oval sheet metal duct work fabricated from hot-dip galvanized steel, with construction and gauge as recommended in SMACNA Low and Medium Velocity Duct Construction Standards.

1. **Gages, Round Ductwork:** Fabricate steel ductwork (galvanized and stainless, if any) from the following minimum gages for diameters up to the corresponding maximum dimensions indicated:

   a. 24 gage up to 8" diameter.
   b. 22 gage up to 22" diameter.
   c. 20 gage up to 36" diameter.
   d. 20 gage up to 50" diameter.
   e. 18 gage up to 60" diameter.
   f. 16 gage up to 84" diameter.
   g. Larger diameter round ductwork not permitted.

2. **Flexible duct shall be insulated type, with woven fiberglass inner lining on vinyl-coated spring steel wire helix, fiberglass insulation shall be a minimum 1" thick with outer vapor barrier jacket of seamless aluminum pigmented plastic vapor barrier jacket, "C" value at 75 deg. F. maximum .23 btu/in./sq.ft./deg F/hr. The flexible duct shall be rated for 16 inches of water column maximum positive and 2 inches of water column maximum negative pressure and 6000 FPM maximum velocity. The duct shall be listed by Underwriters Laboratories under UL-181 and shall comply with NFPA standards 90A and 90B. The duct shall have flame spread rating of less than 25 and smoke developed rating of less than 50. The duct shall be Thermaflex Type M-KC or approved equal Wiremold, Genflex, Clevaflex, Owens-Corning.

C. **Flexible ducts:** Corrugated aluminum or non-combustible fabric, shall not exceed 6 feet in length, supported by helically wound steel wire or flat steel strips.

D. **Fasteners:** Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts. Sheet metal screws must not extend into the air flow where lime can accumulate.

E. **Duct Sealant:** No-hardening, non-migrating mastic or liquid elastic sealant (type applicable for the fabrication/installation detail) as compounded and recommended by the manufacturer specifically for sealing joints and seams in ductwork.

F. **Rectangular ducts which terminate with an open end shall have the opening framed with galvanized steel angles, with 1/2" mesh galvanized hardware cloth cover.**

G. **Plenums shall be constructed with galvanized steel framing members and galvanized sheet steel, cross broken and rigidly braced with galvanized angles. Gages and bracing shall conform to SMACNA recommendations for ductwork of like size. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.**

H. **Turning vanes type as per SMACNA HVAC Duct Construction Standards.**

2.2 **FABRICATION**

A. **Shop fabricate ductwork in 4, 8, 10, or 12-foot length, unless otherwise indicated or required to complete runs. Pre-assemble work in the shop to the greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to the extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.**
B. Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 18 inches, cross break for rigidity. Open corners are not acceptable.

C. Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

D. On rectangular elbows, provide approved air foil type turning vanes. All elbows shall be a minimum of two gages heavier than straight lengths of equal duct size.

E. Increase duct sizes gradually, not exceeding 15 deg. divergence wherever possible. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence down-stream.

F. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

G. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.

H. Fabricate ductwork with duct liner in each section of duct. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners to conform to SMACNA recommendations.

I. Provide off-sets where needed when low pressure ductwork conflicts with piping and structure. Such off-sets to avoid conflicts and reestablished duct to original configuration shall be smooth as possible. If conflict warrants splitting into two ducts, maintain original pressure loss per 100 ft. of duct.

J. Provide necessary baffling entering mixed air plenums to ensure good mixture air temperature with minimum variations of temperature.

PART 3 – EXECUTION

3.1 GENERAL

A. Ductwork shall be routed as indicted on the Engineering Drawings and shall be coordinated by the Contractor with all other phases of the projects.

3.2 INSTALLATION

A. The ductwork shall be fabricated and erected by the sheet metal Contractor in a thorough and workmanlike manner and all joints and seams shall be made as nearly airtight as modern sheet metal practice will permit. The ductwork systems shall not breathe or rattle when they are in operation.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with springloaded metal cap, sprung plastic plug or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

C. The interior surfaces of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or anything else (except duct liner fasteners) may project into the air ducts for any reason unless specified to do so. All seams and joints shall be external.
D. Prior to system operation, the interior of all ductwork shall be thoroughly cleaned by the Contractor. All fans shall be operated and all debris and foreign matter shall be removed from the ducts.

E. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent the entrance of dust and debris until the time connections are to be completed.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Coordinate duct installations with installation of accessories, dampers, equipment, controls and other associated work of the ductwork system.

3.3 CROSS BREAKING OR BEADING

A. Except as specified below, all duct sizes larger than 18" between joints or reinforcing shall be cross broken or beaded. If beading is used, 1 x 1 x 1/8" reinforcing shall be provided on 3' centers.

3.4 SEALING OF JOINTS

A. All joints in ducts, casings, and plenums shall be sealed to prevent air leakage. Leakage shall not be observable by sight, sound or feeling. A sealer, Benjamin Foster Company No. 32-14 adhesive or approved, shall be applied to every joint inside plenums. The sealer between mating flanges shall be applied and surfaces shall be smoothed out at inside of ducts after joints are pulled up tight.

B. Nashua FR357 duct tape, or approved equal sealing tape shall be applied over each joint of ductwork before any external insulation is applied. Both the sealer and tape shall have flame spread rating less than 25 and smoke developed rating less than 50.

C. Hard Cast Joints: All the transverse and longitudinal joints, of all supply air ducts. The adhesive shall be FTA-20 manufactured by Hard Cast Company or approved equal. The adhesive shall be non-toxic, non-flammable, UL approved and shall have flame spread rating less than 25 and smoke developed rating less than 50. The adhesive shall be used in conjunction with Hard Cast DT type duct tape. The adhesive and DT tape shall provide airtight joints for all supply ducts mentioned above. The adhesive shall be of the quality that does not require pre-cleaning of ducts and can adhere to oil and damp duct surfaces.

3.5 AIR MEASUREMENT OPENINGS (TEST HOLES)

A. Air measurement openings of 3/4" diameter, at not more than 12" on center, shall be provided in supply duct from each fan. They shall be located to permit instrument traverse across entire duct, and shall be located as far from elbow as possible but ahead of any air outlet. Additional test openings shall be provided if requested by the air balancing agency. Each opening shall be provided with Ventlok No. 699 instrument test hole or approved equal.

3.6 FLEXIBLE DUCT

A. Flexible ducts shall be furnished at locations shown on the Engineering Drawings. The flexible ducts shall not exceed 6' in length (unless stated otherwise on the Drawings), and shall be installed
in as straight line as possible without any kink. Bends shall not exceed 180 deg. total, with a minimum radius of 2 times inside diameter. Support flexible duct to achieve long sweeping radius and maintain full air flow.

3.7 SCREENS

A. Provide screens on all duct openings unless noted otherwise, which lead to, or are outdoors and are not provided with screened louvers. Screens shall be No. 16 gage galvanized steel mesh attached to removable galvanized steel frame.

3.8 PENETRATION CLOSURES

A. Provide closures around all openings in floors or walls through which ducts are passing. Contractor shall install in a manner to provide airtight seal between wall or floor and duct.

END OF SECTION 233100
SECTION 233300 - DUCT ACCESSORIES

PART 1 – GENERAL

1.1 GENERAL

A. The general provisions of the Contract, including Uniform General Conditions and Special Conditions, the General Conditions for Mechanical and Plumbing Work, and General Requirements (if any), apply to the work specified in this section.

1.2 WORK INCLUDED

A. Access Doors.
B. Balancing Dampers.
C. Backdraft Dampers.
D. Flexible Connections.

1.3 REFERENCE STANDARDS

A. Underwriters Laboratory.
C. Sheet Metal and Air Conditioning Contractors National Association.
D. ASHRAE Handbook of Fundamentals.
E. Air Movement and Control Association.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of duct accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
B. Installer: A firm with at least three (3) years of successful installation experience on projects with duct accessories work similar to that required for project.
C. Access doors shall be UL labeled.
D. Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems.
E. Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.
F. Acceptable Manufacturers: MILCOR, RUSKIN, GREENHECK or approved equal.
1.5 SUBMITTALS

A. Submit as specified in Uniform General Conditions & Special Conditions.

B. Submit shop drawings of factory fabricated assemblies.

C. Submit samples of shop fabricated assemblies as requested.

D. Manufacturer's installation instructions.

PART 2 – PRODUCTS

2.1 ACCESS DOORS

A. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Install minimum 1 inch thick insulation with suitable sheet metal cover frame for insulated ductwork.

B. Fabricate with two butt hinges and two sash locks for sizes up to 18 inch, two hinges and two compression latches with outside and inside handles for sizes up to 24 inch x 48 inch and an additional hinge for larger sizes.

C. Where access doors are shown on plenums, hinged doors with No. 202 Ventlok or approved equal latch shall be provided.

2.2 BALANCING DAMPERS

A. Fabricate of galvanized steel, minimum 16 gage, and provide with quadrants or adjustment rod and lock screw.

B. Volume dampers located in supply ducts shall be opposed blade inter-locking type. Minimum duct size, two blades, 6” W x 12” H. Blades shall be of not less than 16 gage galvanized steel, maximum 48” length and 6” width, supported on shafts with self-lubricating bearings. Assemble center and edge crimped blade in prime coated or galvanized channel frame with approved type hardware. The damper frame shall be a minimum of 2” x 1/2” x 1/3” 16 gage galvanized steel. Splitter dampers shall not be acceptable.

C. At locations other than in supply ducts, the volume dampers shall be opposed blade type of the same construction as described above for supply ducts, except they may be either factory or shop made.

2.3 BACKDRAFT DAMPERS

A. Fabricate multi-blade, parallel action gravity balanced backdraft dampers with blades a maximum of 6 inch width having felt or flexible vinyl sealing edges, linked together in rattle-free manner and with adjustment device to permit setting for varying differential static pressure.
2.4 FLEXIBLE CONNECTIONS

A. Fabricate of approved neoprene coated flameproof fabric approximately 2-1/2 inch wide tightly crimped into metal edging strip and attach to ducting and equipment by screws or bolts at 6 inch intervals.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturer’s instructions.

3.2 APPLICATION

A. Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers and else where as indicated. Review locations with Texas Parks and Wildlife Department (TPWD) Construction Manager prior to fabrication.

B. Provide 4 inch x 4 inch quick opening access doors for inspection at balancing dampers.

C. At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

D. Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger ducts as required for proper air balancing.

E. Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and where indicated on the mechanical drawings.

3.3 CONNECTIONS

A. Branch connections in ductwork system shall be made in accordance with SMACNA manual unless otherwise shown on the Engineering Drawings.

B. A round duct branch shall be provided with a conical spin-in take-off fitting manufactured with air tight seams using a locking double seam. Unit shall be constructed using no lighter than 26 gage galvanized steel.

3.4 BALANCING DAMPERS

A. Furnish balancing dampers where shown on the Engineering Drawings and wherever necessary for complete control of air flow, including all supply and return branches, “Divisions” in main supply and return ducts, each individual air supply outlet and outside air ducts. Provide multi-blade volume dampers in all zone ducts at multi-zone air handling units.

B. Furnish counterbalanced backdraft dampers where indicated on the Engineering Drawings. Each damper shall be sized as indicated on the Engineering Drawings and shall be suitable for installation in the mounting arrangement shown.
3.5 ACCESS DOORS

A. An access door shall be furnished and installed by the sheet metal Contractor (unless impractical to pre-install as permitted by Contractor) at each automatic damper, fire damper, duct mounted controller or transmitter and at duct mounted temperature sensor. Additional access doors shall also be provided by sheet metal Contractor where indicated on the Engineering Drawings. Access doors or panels shall be insulated in insulated ducts and sizes shall be as per Engineering Drawings. Larger panels shall be in accordance with SMACNA Standards with Ventlok No. 310 handles. All access doors and panels larger than 16” x 12” shall be not less than No. 20 gauge steel. Access doors in plenums shall be constructed in accordance with SMACNA Standards and shall be insulated if adjacent sheet metal is insulated, with polyurethane foam jacket. Structural steel angle shall be provided at each side of door opening, extending from bottom to top of plenum. A 20 gauge 3” wide flange shall be provided around each door opening in insulated surfaces, extending over insulation. All access doors and panel hardware shall be Ventlok or approved equal.

B. All access panels in unaccessible ceiling and walls, where shown on the Engineering Drawings or required, shall be furnished and installed by the General Contractor.

3.6 FLEXIBLE CONNECTIONS

A. Flexible connections shall be provided on suction and discharge side of each fan, at duct connections to air handling units, and where otherwise shown on the Engineering Drawings or required. The flexible connections shall be securely and firmly attached so that a minimum of 2” clearance is provided between metal members. The flexible connections shall be stitched and not stapled and shall be airtight. They shall be installed so as to provide 1” movement in all six modes of vibration for connections 12” and larger. Provide 1/2” for smaller connections.

B. Angle flanges shall be provided for all duct and equipment connections larger than 18” in width, height or diameter.

END OF SECTION 233300
SECTION 233416 – FANS

PART 1 – GENERAL

1.1 GENERAL

A. The general provisions of the Contract, including Uniform General Conditions and Special Conditions, the General Conditions for Mechanical and Plumbing Work, and General Requirements (if any), apply to the work specified in this section.

1.2 WORK INCLUDED

A. Ceiling mounted exhaust fan
B. Inline exhaust fan.

1.3 REFERENCE STANDARDS

A. Fans shall meet the requirements of AMCA Standard 210
B. ASHRAE Handbook of Equipment
C. Underwriters Laboratories, Inc.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of fans, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
B. Installer: A firm with at least three (3) years of successful installation experience on projects with fans work similar to that required for project.
C. Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.
D. Acceptable Manufacturer: ACME, GREENHECK, LOREN COOK, CO., CARNES or approved equal.

1.5 SUBMITTALS

A. Submit shop drawings as specified in Uniform General Conditions & Special Conditions.
B. Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves.
1.6 JOB CONDITIONS

A. Do not operate for any purpose, temporary or permanent until ductwork is clean, filters in place, bearings lubricated and fan has been run in under close supervision.

1.7 ALTERNATIVES

A. Equivalent fan selections shall not increase motor horsepower (wattage), increase noise level, increase tip speed by more than 10% or increase inlet air velocity by more than 20%, from that specified.

B. Equivalent fan selections shall be capable of demonstrating fan curves, with fan and system operating point plotted on curves, which are equal to or exceeds that for the fan curves for fans scheduled on the drawings.

PART 2 – PRODUCTS

2.1 GENERAL

A. Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

B. Provide balanced variable sheaves for motors 15 hp (11.2 kw) and under and fixed sheave to 20 hp (15 kw) and over.

C. Fans shall be capable of accommodating static pressure variations of +/- 10% with no objectionable operating characteristics.

2.2 CEILING MOUNTED EXHAUST FAN

A. Housing: Steel, lined with acoustical insulation.

B. Fan wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

C. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attached to fan housing.

D. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

E. Accessories: Fans shall be provided with neoprene vibration isolators, rattle free, back draft damper, disconnect switch and accessories listed on the Exhaust Fan Schedule.

2.3 INLINE EXHAUST FANS

A. Duct mounted exhaust fans shall be of the centrifugal direct or belt drive in-line type. The fan housing shall be constructed of heavy gauge steel sheet.

B. The fan wheel shall be of the non-overloading centrifugal type. Wheels shall be dynamically and statically balanced and shall overlap the spun inlet venturi for maximum performance.
C. Motors shall be of the heavy duty type with permanently lubricated and sealed ball bearings for ten years operation. Drives shall be sized for minimum of 156% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. The motor pulleys shall be adjustable for final system balancing.

D. Accessories: Fans shall be provided with neoprene vibration isolators, disconnect switch, mounting brackets and accessories listed on the Exhaust Fan Schedule.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Where inlet or outlet is exposed, provide safety screen.

B. Provide belt guards on belt driven fans.

C. Supply and install sheaves as necessary for final air balancing.

3.2 PERFORMANCE

A. Refer to Fan Schedule as shown on drawings.

END OF SECTION 233416
SECTION 233700 - AIR DISTRIBUTION DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION
A. This Section specifies the requirements for providing ductwork and accessories including:
   1. Ductwork.
   2. Ductwork Fittings.
   3. Flexible Connections.
   4. Volume Control Dampers.
   5. Damper Regulator Sets.

1.2 SYSTEM DESCRIPTION
A. Definition
   Air-conditioned and heated spaces are spaces directly supplied with heated or conditioned air or provided with a heating or cooling coil device such as a fan coil unit.
B. Classification
   All ductwork shall be classified in accordance with latest revision of SMACNA HVAC Duct Construction Standards.

1.3 QUALITY ASSURANCE
A. Reference Standards Applicable to this Section
   1. AMCA: Air Movement and Control Association, Inc.
      a. 500: Test Methods for Louvers and Dampers.
   2. ASC: The Adhesive and Sealant Council, Inc.
   3. ASTM: American Society for Testing and Materials
      b. A 123: Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bar and Strip.
      d. A 386: Specification for Zinc-Coating (Hot-Dip) on Assembled Steel Products.
      e. A 525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
   a. Architectural Metals

5. NFPA: National Fire Protection Association
   b. 90B: Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

6. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
   a. HVAC Duct Construction Standards - Metal and Flexible.
   b. Fire Damper and Heat Stop Guide.

7. UL: Underwriters Laboratories, Inc.
   a. 555: Fire Dampers.

B. Equipment shall be produced by a manufacturer of established reputation with a minimum of 5 years experience supplying specified equipment.

C. Provide a qualified manufacturer's representative at site to inspect equipment installation, check out and start-up.

D. Provide a technical representative to train the Owner's personnel in the safe operation and maintenance of the equipment.

1.4 SUBMITTALS

A. Submittals shall be prepared according to the terms of the Contract and as specified by Uniform General Conditions & Special Conditions.

B. Specific items to be submitted:

   1. Manufacturer's literature shall include comprehensive performance data developed from testing in accordance with AMCA Standard 500 and shall illustrate pressure drops for all sizes of dampers required at all anticipated air flow rates.
   2. Manufacturer's literature indicating product specifications, installation instructions and procedures.
   3. Shop Drawings indicating equipment, damper location, duct layouts, flexible connections, duct access door locations and dimensions.

1.5 PRODUCT DELIVERY AND HANDLING

A. Deliver equipment in sealed manufacturer's containers, appropriately packaged and crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including containers contained within others, on outside with item description(s) per title, Mark Numbers, and this Section number.
1.6 LABELING

A. Manufacturer shall securely attach in a prominent location on each major item of equipment a 316 Stainless Steel nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.

PART 2 – PRODUCTS

2.1 DUCTWORK

A. Ductwork Materials


B. Ductwork Fabrication

All ductwork shall be fabricated and installed in a workmanlike manner. Duct shall be straight and smooth on the inside with neatly finished joints, airtight, and shall be free from vibration under all conditions of operation. The internal ends of slip joints shall be made in the direction of air flow. Changes in dimensions and shape of duct shall be gradual.

Curved elbows, unless otherwise indicated shall have a center line radius equal to 1-1/2 times the width of the duct. Where ductwork is connected to fans, air handling units or other equipment that may cause vibration, ducts shall be connected by means of a flexible connection constructed of fire resistant neoprene coated fiberglass. All ductwork shall meet SMACNA HVAC construction standards.

2.2 DUCTWORK FITTINGS

A. Turning Vanes

SMACNA HVAC Duct Construction Standards.

2.3 FLEXIBLE CONNECTIONS

A. Fan Flexible Connections shall be Ventglas as manufactured by Ventfabrics, Inc. or approved equal.

2.4 VOLUME CONTROL DAMPERS

A. Supply and install as shown on the drawings, following Volume Control Dampers.

1. Opposed Blade Damper

Frame: 3 ½ in. x 5/8 in. x 16 gauge galvanized steel channel.
Blade: 16 gauge galvanized steel with EPT seals.
Axle: 1/2 in. dia. galvanized steel with a 6 in. extension.
Bearings: Nylon sleeve with stainless steel thrust washers.
Finish: Factory applied enamel or aluminum paint.

Damper to be American Warming and Ventilation Inc. (AWV) No. VC-21
2. Round, single blade, 6 in. through 18 in. diameter.
   Frame: 2 in. x 1/2 in. x 14 gauge galvanized steel channel.
   Blade: 16 gauge galvanized steel with EPT seals.
   Axle: 1/2 in. dia. galvanized steel with a 6 in. extension.
   Bearings: Nylon sleeve with stainless steel thrust washers.
   Stops: No. 10 clad plated sheet metal screws for the open and closed position.
   Finish: Factory applied enamel or aluminum paint.
   Damper to be American Warming and Ventilation Inc. (AWV) No. VC-22.

2.5 DAMPER REGULATOR SETS
   A. Ventline quadrants No. 560 by Ventfabrics.

2.6 GRILLES, REGISTERS AND DIFFUSERS
   A. Supply diffusers shall be as scheduled on Drawings.
   B. Return air grilles shall be as scheduled on Drawings.
   C. Exhaust registers shall be as scheduled on Drawings.
   D. Manufacturers: Metalaire, Titus, Krueger or Price.

PART 3 – EXECUTION

3.1 INSPECTION
   A. Existing and adjoining work shall be examined for adverse or detrimental conditions that prevent proper installation.
   B. Do not proceed with installation until all unsatisfactory conditions have been corrected.

3.2 DUCTWORK
   A. Ductwork shall be installed and sealed for minimum leakage in accordance with the applicable requirements of SMACNA HVAC Duct Construction Standards, NFPA 90A, NFPA 90B, and as indicated.
   B. Ductwork shall be kept clean of foreign matter. Interior of ductwork shall be closed off during construction to prevent entrance of debris.
   C. Ductwork shall be run vertically and horizontally, parallel or perpendicular to building structure, avoiding diagonal runs.
   D. Ductwork shall be run so as to prevent obstruction of usable space and to avoid blocking of access for servicing building and equipment.
E. Ductwork layout shall be coordinated with architectural louvers and grilles, lighting layouts, electrical raceway, piping, and equipment installation layouts prior to commencing installation.

F. Where ducts pass through interior partitions, space between partition openings and duct shall be concealed with galvanized sheet steel flanges of same gauge as duct. Flange shall extend a minimum 1-1/2 in. beyond partition.

3.3 FLEXIBLE CONNECTIONS

A. Insulated flexible connections shall be limited to concealed areas and shall be made in accordance with SMACNA HVAC Duct Construction Standards. Connections shall be limited to a maximum of 6 feet in length.

3.4 VOLUME CONTROL DAMPERS

A. Dampers shall be installed in accordance with damper manufacturer's instructions and procedures.

B. Dampers shall be installed to be readily adjustable and serviceable.

C. Dampers shall be installed to be free of strain or distortion that prevents their free, unrestricted movement.

3.5 DAMPER OPERATORS

A. Damper operators shall be installed in accordance with operator manufacturer's instructions and procedures.

3.6 GRILLES, REGISTERS AND DIFFUSERS

A. Grilles, registers and diffusers shall be installed in accordance with the grille manufacturer's instructions and procedures and as indicated.

3.7 TESTING AND BALANCING

A. Testing and balancing shall be as specified in Section 230593 - Testing, Adjusting, and Balancing.

END OF SECTION 233700
SECTION 234100 - AIR FILTERS

PART 1 – GENERAL

1.1 SECTION INCLUDES
A. Disposable panel filters with metal holding frames.
B. Filter gauges.

1.2 REFERENCES
A. ARI 850 - Commercial and Industrial Air Filter Equipment.
C. UL 900 - Test Performance of Air filter Units.

1.3 PERFORMANCE TOLERANCES
A. Conform to ARI 850 Section 7.4.
B. Dust Spot Efficiency: Plus or minus 5 percent.

1.4 SUBMITTALS
A. Submit under provision of Uniform General Conditions & Special Conditions.
B. Shop Drawings: Indicate filter assembly and filter frames, dimension and connection requirements.
C. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions and connection requirements.

1.5 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of General Requirements.
B. Operation and Maintenance Data: Include instructions for operation, changing and periodic cleaning.

1.6 EXTRA MATERIALS
A. Provide two sets of specified filters for each unit.
B. At final acceptance, remove the initial set of specified filters and install the second set.
PART 2 – PRODUCTS

2.1 DISPOSABLE PANEL FILTERS WITH METAL HOLDING FRAMES (Type A)

A. Manufacturers:
   2. Cambridge Model 4SP.

B. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
   1. Nominal Size: 12 x 24 inches, 16 x 25 inches, 24 x 24 inches.
   2. Thickness: 2 inch.

C. Performance Rating:
   1. Face Velocity: 500 FPM.
   2. Initial Resistance: 0.22 inch WG.
   3. Recommended Final Resistance: 1.00 inches WG.

D. Holding Frames: 18 gauge minimum galvanized steel frame with 11 gauge grid on outlet and inlet side, hinged with pull and retaining handles.

2.2 FILTER GAUGES

A. Manufacturers:

B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment.

C. For filters with final resistance of 1.5" or less, provide 0-2.0 inch WG range. For filters with final resistance greater than 1.5", provide 0-4.0 inch WG range.

D. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves, mounting panel with screws.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber or neoprene gaskets.

C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

E. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

END OF SECTION 234100
SECTION 237313 – PACKAGED A/C UNITS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the Uniform General Conditions and Special Conditions apply to the work specified in this section.

B. The Basic Materials and Methods, Section 230000, are included as a part of this Section as though written in full in this document.

1.2 DESCRIPTION OF WORK

A. Scope: This section specifies the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner’s use.

1.3 SUBMITTALS

A. Submittals shall be prepared according to the terms of the Contract and as specified by Uniform General Conditions & Special Conditions.

B. Specific items to be submitted:

1. Manufacturer’s literature shall include comprehensive performance data developed from testing in accordance with AMCA Standard 500 and shall illustrate pressure drops for all sizes of dampers required at all anticipated air flow rates.

2. Manufacturer’s literature indicating product specifications, installation instructions and procedures.

PART 2 – PRODUCTS

2.1 VARIABLE AIR CONDITIONING UNIT

A. Variable Air conditioning unit shall be packaged, horizontal discharge and include electric cooling with capacity and steps of cooling as shown on Drawings.

B. Unit shall be factory-charged and tested, shall be UL-labeled and ARI-certified by Standard 210 and 270, and shall be AGA-certified.

C. Unit casing shall be heavy-gauge galvanized steel or heavy-gauge aluminum with weather-resistant baked enamel protective coating. Weatherproof access panels shall be provided for access to all parts requiring service. Cabinet construction shall allow for all maintenance on one side of the unit.

D. The eFlex variable speed compressor(s) shall be capable of speed modulation from 15Hz to a maximum of 75 Hz. sealed or serviceable hermetic type and shall be resiliently mounted to avoid vibration and noise. The minimum unit capacity shall be 25% of full load or less.
Compressor shall be provided with anti-slugging protection, crankcase heater, and time delay on recycling of the compressor. Two internal compressor motor thermal cutouts and a hot gas cutout shall protect the compressor in addition to high-pressure and low-pressure safeties. Standard controls shall permit operation down to 35°F (2°C) and compressor shall be locked out below this temperature. The compressor motor shall be a permanent magnet type. Each variable speed compressor shall be matched with a special designed, refrigerant-cooled, variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions. Each compressor shall have a crankcase heater installed.

E. Condenser fan(s) shall be direct-driven on the shaft of the slow-speed motor, which shall be designed to operate exposed to the weather.

F. Condenser coils shall have a sub-cooling section.

G. Refrigerant circuit shall include filter dryer, moisture indicator, sight glass, and gauge ports.

H. Filter rack shall be provided for filters 2 in. thick and shall filter both outdoor air and return air. See Section 234100 of these Specifications for type of filters and the number of filter changes to be furnished with the equipment.

I. Evaporator fan shall be quiet-type centrifugal blower, directly connected to an adjustable-speed motor or belt driven with an adjustable-pitch pulley on the motor.

J. Control: Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring.

K. Evaporator and condenser coils shall be internally finned 5/16” copper tubes mechanically bonded to a configured aluminum plate fin. Provide cathodic epoxy type electrodiposition coating for plate fins and heat exchangers.

2.2 ACCESSORY EQUIPMENT

A. Condenser coil guards shall be provided for all units.

B. Mounting frame shall be provided for all units mounted on the floor. Frame shall be approved by the National Roofing Contractors Association. Provide all necessary flashing and counterflashing.

C. Provide “power saver” dampers and controls to provide “free cooling” from 0 to 100% outdoor air (OA) when the outside air humidity and temperature are acceptable. Provide OA, return air, and relief air dampers in a factory-provided enclosure. All air shall be filtered and bird screen shall be installed.

D. A solid state enthalpy changeover control shall determine the capability of the outside air to provide free cooling. The control package shall include a differential enthalpy sensor in the return air duct to compare the enthalpy of the outside air and return air and use the air with the lowest enthalpy for free cooling or assisting the mechanical cooling. The cooling control sequence is as follows:

1. The changeover control determines if the outdoor air is suitable for free cooling.
2. The space thermostat determines if cooling is needed in the building. If so:
3. The actuator modulates the outdoor air and return air dampers to maintain the desired mixed air temperature.
4. The second cooling stage of the space thermostat energizes the compressor to assist the economizer if required.

5. If the outdoor air is not suitable for free cooling, the outdoor air damper remains in the minimum ventilation position and the compressor is energized when space cooling is required.

E. Provide a warm-up thermostat to prevent the OA dampers from opening if the return air temperature is below the set point 64°F (18°C).

F. Provide necessary controls for operation of the compressor below the normal temperature of the compressor cutout. Operation shall be permitted down to temperature specified on Drawings.

G. Provide factory-trained service person to check out the system, calibrate the controls, and see that the RTU is operating properly. The service person making the settings shall make a written report to Texas Parks and Wildlife Department (TPWD) Construction Manager with all set points listed for future references.

H. Rooftop units mounted on slabs or other fixed locations shall be provided with adapters for end discharge and return to the unit.

I. Provide thermostat and other controls required to produce the control functions called for.

2.3 ACCEPTABLE MANUFACTURERS

A. Packaged air conditioning unit shall be the make and model shown on the schedule on Drawings, or approved equivalents.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install the curb as required by the job conditions and as recommended by the manufacturer, and install proper flashing and counterflashing. See details on Drawings.

B. Set the unit in place, taking care to protect the adjacent building and connect the supply and return ductwork.

C. Make electrical connections, taking care that these do not block access to any part of the equipment requiring service.

D. Have the factory service person check out the unit and make a written report. Place the unit in service.

3.2 BALANCING AND TEST

A. Operate the rooftop unit and check for proper supply air quantity, noise, and proper operation.

B. Report the airflow, static pressure, voltage and current draw of each item, refrigerant pressure readings, etc., as required by Section 230593 of these Specifications. This system is not complete until these readings have been made, submitted to Texas Parks and Wildlife Department (TPWD) Construction Manager, and accepted.

END OF SECTION 237313
SECTION 260000 - GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. General: This Division covers electrical materials and electrical workmanship. The electrical drawings delineate materials, physical arrangement, details and schedules.

B. The general provisions of the contract, including Uniform General Conditions and Special Conditions, apply to the work specified in this section.

1.2 SCOPE OF WORK

A. The Electrical Contractor and his sub-contractors for the work of this section shall fully inform themselves of the extent of each part of the project that encompasses work by that trade and shall furnish all necessary equipment, tools, labor, materials, transportation, services and facilities required for the complete installation of all electrical work as shown on the plans or outlined in these specifications. The work shall include all materials, accessories, and apparatus not specifically mentioned herein or noted on the plans, but which are necessary for installation of all systems specified.

Work consists of, but is not limited to:

1. Demolition
2. Electrical service entrances
4. Distribution panels, power and lighting
5. Site lighting and lighting controls.
6. Underground duct banks.
7. Miscellaneous outlets, devices and disconnects.
8. Obtain and pay for all required electrical permits and fees.

1.3 REFERENCE STANDARD

A. Refer to individual sections.

B. If general statements in the specifications should appear to conflict with specific notations in the specifications or drawings, the specific shall govern.

1.4 QUALITY ASSURANCE

A. Applicable Standards

1. Codes: All electrical work shall conform with the requirements and recommendations of the 2017 edition of the National Electrical Code and all local codes and ordinances. In conflicts between codes, the more stringent requirements shall govern.

2. Standards: The specifications and standards of the following organizations are by reference made a part of these specifications and all electrical work, unless otherwise
indicated, shall comply with their requirements and recommendations wherever applicable:

- Association of Edison Illuminating Companies (A.E.I.C.)
- Institute of Electrical and Electronic Engineers (I.E.E.E.)
- American National Standards Institute (A.N.S.I.)
- American Society of Testing Materials (A.S.T.M.)
- Certified Ballast Manufacturers (C.B.M.)
- Electrical Testing Laboratories (E.T.L.)
- Insulated Power Cable Engineers Association (I.P.C.E.A.)
- National Bureau of Standards (N.B.S.)
- National Electrical Contractors Association (N.E.C.A.)
- National Electrical Manufacturer's Association (N.E.M.A.)
- National Fire Protection Association (N.F.P.A.)
- Reflector Luminaire Manufacturers (R.L.M.)
- Underwriter's Laboratories, Inc. (U.L.)

B. Requirements of Regulatory Agencies: The requirements and recommendations of the latest edition of the Occupational Safety and Health Act are by reference made a part of these specifications and all electrical work shall comply with their requirements and recommendations wherever applicable.

C. Interferences: Electrical Drawings are generally of a diagrammatic nature. Except where dimensioned locations are shown, plan and coordinate the work to eliminate interferences with other trades. Provide all fixture and equipment locations and provide all supporting materials required for a planned, coordinated and neat installation. Where interferences occur, the Owner's authorized representative will decide which items must be relocated regardless of which was installed first.

D. Electrical Workmanship: Use only personnel skilled in the trades involved.

E. Electrical Materials: Provide all materials used in this work, unless particularly specified otherwise, that are new and free from flaws or imperfections.

F. Excavation, Trenching, Backfilling and Compaction: Execute all excavation, trenching, backfilling and compaction required for this work in accordance with applicable section of specification.

G. Cutting and Patching: Execute all cutting and patching required for this work in accordance with applicable section of specification.

H. Sleeves and Inserts: Furnish and locate all sleeves and inserts required for this work as required.

I. Painting: Limit painting of factory-finished equipment to touching up unless specified otherwise.
J. Testing: In addition to testing required under these specifications, Owner reserves the right to conduct independent acceptance tests on such portions of the installation as he sees fit. Acceptance tests will be to determine fulfillment of contract requirements and will be conducted in the presence of authorized representative of Contractor and Designer. Timely notification of acceptance tests will be given. Correct all deficiencies in materials and workmanship revealed by the acceptance tests.

1.5 INSTALLER QUALIFICATIONS

A. An acceptable contractor must have experience to provide a practical working system and employ skilled craftsmen.

1.6 UTILITY SERVICES

A. Before beginning work on the services, review the work with the local power and telephone companies. Comply with all their requirements whether shown on the drawings or not. Extend services as required. All costs for utility services are to the Contractor’s account.

1.7 CONTRACT DRAWINGS

A. Intent: The intent of the drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system. Electrical drawings are generally diagrammatic and show approximate location and extent of work. Install the work complete, including minor details necessary to perform the function indicated. In case of doubt as to work intended, or if amplification or clarification is needed, request instructions from the Texas Parks and Wildlife Department (TPWD) Construction Manager.

B. Discrepancies: Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Texas Parks and Wildlife Department (TPWD) Construction Manager for his interpretation.

C. Outlet and Equipment Locations: Coordinate the actual locations of electrical outlets and equipment with building features and mechanical equipment as indicated on Architectural, Structural and Mechanical drawings. Review with the Texas Parks and Wildlife Department (TPWD) Construction Manager any proposed changes in outlet or equipment location. Remove and relocate outlets placed in an unsuitable location, when so requested by the Texas Parks and Wildlife Department (TPWD) Construction Manager.

1.8 REGULATIONS AND PERMITS

A. Regulations: Work, materials and equipment must comply with the adopted codes and standards, including but not limited to the following:

3. Occupational Safety and Health Act (OSHA).
4. Local codes and ordinances.
5. State and Federal codes, ordinances and regulations.
B. Discrepancies: The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Texas Parks and Wildlife Department (TPWD) Construction Manager in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Permits: Obtain certificates of inspection and other permits required as a part of the work.

PART 2 – PRODUCTS

2.1 SHOP DRAWINGS AND PRODUCT DATA

A. Data Required: Submit shop drawings and product data as specified in Uniform General Conditions & Special Conditions. Submittal data must show published ratings or capacity data, detailed equipment drawing for fabricated items, panel diagrams, wiring diagrams, installation instructions and other pertinent data.

B. Form of Submittal: Submit data for review before placing purchase orders. Organize data in a 3-ring binder indexed by specification reference. Show any revisions to equipment layout required by use of selected equipment.

C. Submittal Items: Submittals are required for, but are not limited to, the following items:

1. Shop drawings, and product data.
   a. Catalog cuts of all lighting fixtures, identified by assigned type designation.
   b. List of low voltage insulated wire and cable with each type identified by manufacturer’s designation.
   c. Circuit breakers, fuses and transformers.
   d. Lighting control panel, relays, and digital switches.
   e. Continuous rigid cable supports.
   f. Wiring devices, conductors.
   g. Grounding materials and equipment.

2. Warranty: Copy of specific warranty per equipment or system.
3. Maintenance: Copy of specific service or maintenance policy per equipment or system.

2.2 PRODUCT REQUIREMENTS

A. Condition: Materials and equipment provided under these specifications must be new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer’s latest standard design for the type of equipment specified.

B. Labels: Products must conform to requirements of the National Electric Code. Where Underwriters’ Laboratories have set standards, listed products and issued labels, products used must be listed and labeled by UL.

C. Underground marking tape: Tape shall be polyethylene, .004 inches thick, 6 inches wide.
D. Space Limitations: Equipment selected must conform to the building features and must be coordinated with them. Do not provide equipment which will not suit arrangement and space limitations.

E. Factory Finish: Equipment must be delivered with a hard surface, factory-applied finish so that no additional field painting is required.

2.3 SUBSTITUTIONS

A. Substitute Provision: If contractor proposes to substitute any product for that specified, he must provide pertinent data in the products list for the Texas Parks and Wildlife Department (TPWD) Construction Manager’s consideration prior to bid refer to Uniform General Conditions & Special Conditions.

1. Requests for substitution are understood to mean that the Contractor will, at his own expense, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.

2. Substitutions will not be considered if a substantial revision of the contract documents is required.

PART 3 – EXECUTION

3.1 EXECUTION

A. Moisture: During construction, protect motors, control equipment, and other items from moisture. Protect metallic components from corrosion. Apply protection immediately on receiving the products and maintain continually.

B. Clean: Keep products clean by elevating above ground or floor and by using suitable coverings.

C. Damage: Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

D. Finish: Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore or replace any finishes that become stained or damaged.

3.2 INSTALLATION

A. Cooperation with Other Trades: Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades.

B. Workmanship: Work must be performed by workmen skilled in their trade. The installation must be complete, whether the work is concealed or exposed.

C. Setting of Equipment: Equipment must be leveled and set plumb. In sufficient time to be coordinated with work of others, provide drawings and layout work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.
D. Motors: Electrical work includes the electrical connection of motors, except those which are wired as a part of equipment.

E. Concealed Work: Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings, except where shown or specified to be exposed.

F. Application: Unless otherwise indicated, power will be utilized as follows:

1. 480 volts or 208 volts, 3 phase: Motors 3/4 horsepower and larger, unless otherwise indicated.
2. 120 volts, single phase: Motors smaller than 3/4 horsepower, unless otherwise indicated.
3. 120 volts, single phase: Convenience outlets, special outlets and controls.
4. 120 volts, 208 volts and 277 volts single phase: Lighting.
5. Low voltage DC as indicated on plans and schedules.

3.3 EQUIPMENT AND DEVICE MARKING

A. Nameplates: Externally mark electrical equipment by means of suitable nameplates identifying each and the equipment served.

B. Nameplate Information: In general, the following information is to be provided for the types of electrical equipment as listed.

1. For each branch circuit protective device, identify the load served.
2. Panelboards: Identify the service source, panelboard designation and voltage characteristics.

C. Panelboards: Prepare a neatly typed circuit directory behind clear heat-resistant plastic for each panelboard. Identify circuits by equipment served and by room numbers. Indicate spares and spaces with light, erasable pencil marking.

D. Boxes and Small Equipment: Pull boxes, individually mounted disconnect switches, motor starters and similar items shall be labeled with 2-color laminated plastic identification nameplates secured with cement and bolts or screws. Plates shall be 3/32-inch thick by 1-inch high and have 1/4-inch letters.

E. Power Receptacles: Use nameplates to identify power receptacles where the normal voltage between any pair of contacts is greater than 150 volts with circuit number, voltage and phases. Use permanent laminated name plates secured with cement and bolts or screws.

F. Wall Switches: Label switch plates of wall switches controlling equipment which is not in sight of the control switch. Use permanent laminated name plates secured with cement and bolts or screws.

G. Location of underground conduit shall be marked by use of underground warning tape, colored with printed message. Tape to be buried directly over pipe, 6-inch below finished grade. Underground warning tapes to be as follows:

2. Telephone conduit - Orange, legend "Telephone Line Buried Below", Seton No. 210 TEL or written approved equal.
3. Main service entrance conduit to be enclosed in red concrete.
3.4 TESTING

A. Testing Conditions: Place circuits and equipment into service under normal conditions, collectively and separately, as may be necessary to determine satisfactory operation. Perform specified tests in the presence of the Texas Parks and Wildlife Department (TPWD) Construction Manager. Furnish all instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the drawings and specifications.

3.5 WARRANTY

A. Warranty: The Contractor shall be held responsible for the manufacturers warranted equipment for a period of one year minimum.

B. Should any equipment become defective during the warranty period, the Contractor shall respond in a timely manner and in turn shall require the manufacturer to correct the deficiency promptly.

   1. This includes all electrical items that require change out, inspection or preventative maintenance such as switchgear, motor controllers, bulbs, ballast, controls, panels, and programmable control panels.
   2. The owners personnel must be in attendance at each replacement.

3.6 O and M MANUALS

A. O and M Manuals: Refer to Uniform General Conditions & Special Conditions for requirements of O and M manuals.

END OF SECTION 260000
SECTION 260003 - TESTS

PART 1 – GENERAL

1.1 GENERAL

A. The Contractor shall inspect, check, adjust, calibrate and test all electrical equipment, materials, and work performed. The Contractor shall provide all labor, materials, equipment and test instruments to perform the requirements of this specification. The inspecting, checking, adjusting, calibrating and testing shall be performed by competent and qualified workmen. The materials, equipment and test instruments used shall be suitable and proper for the purposes of this specification. The procedures and methods used shall be recognized, standard practices for the purposes of this specification. All damaged, defective, deficient and malfunctioning equipment and material furnished by the Contractor shall be promptly reported to the Texas Parks and Wildlife Department (TPWD) Construction Manager for proper disposition prior to proceeding with the work. All damaged, defective, deficient, malfunctioning and otherwise unacceptable materials, equipment and work performed due to any cause shall be replaced or repaired at the Contractor’s expense. Repairs, adjustments and other work of a corrective nature having a compromising or questionable result unsatisfactory to the Texas Parks and Wildlife Department (TPWD) Construction Manager shall not be an acceptable alternate to the complete replacement or reworking.

B. All instruments, materials, personnel, and documentation of test results shall be included in the Work of this Division.

1.2 APPLICABLE PROVISIONS

A. The general provisions of the contract including General and Supplementary conditions and General Requirements apply to the work specified in this section.

B. Tests shall be conducted in accordance with 2019 NETA Acceptance Testing Specifications.

1.3 RECORDS

A. The Texas Parks and Wildlife Department (TPWD) Construction Manager shall be given reasonable advance notice to witness at his discretion all inspections, checks, adjustments, calibrations and tests required by this specification. The results, readings, settings, measurements and data of all inspections, checks, adjustments, calibrations and tests shall be recorded by the Contractor and submitted to the Texas Parks and Wildlife Department (TPWD) Construction Manager in acceptable form.

1.4 POWER DISTRIBUTION CABLE

A. The conductor insulation of the power distribution cable shall be tested after all the terminations have been completed and prior to the final connections and energizing of the cable. A continuity test shall be made for each phase conductor and each grounding conductor. The conductor insulation shall be tested with a 1000 volt insulation tester. The test results and conditions shall be recorded and submitted to the Texas Parks and Wildlife Department (TPWD) Construction Manager.
B. Each new feeder conductor shall have its insulation resistance tested after its installation is completed except for connection at its source and point of termination.

C. Tests shall be made using a Biddle Megger or equivalent at a voltage of not less than 1000 VDC, and after one minute of operation at slip speed. Resistance shall be measured from conductor to conductor, and conductor to ground.

D. Insulation values should not be less than 50 megohms as stated in NETA ATS 2019. Conductors, which do not meet the insulation resistance values shall be removed, replaced, and retested.

E. Submit four (4) copies of certified test results for approval. Results shall indicate weather conditions for tests, feeder tested, conductor size and type and resistance measurements.

1.5 LIGHTING SYSTEM

A. Test the insulation resistance and continuity of all lighting branch circuits. All luminaries shall be properly aimed, aligned and lamped.

1.6 SPECIAL SYSTEMS

A. Exercise care in the checking and testing of all electrical systems so as not to damage special, electronic or instrument circuits. Only qualified personnel shall install and test special systems.

1.7 MISCELLANEOUS

A. All systems under electrical section shall be tested as specified and recommended by manufacturers to meet all codes. Make adjustments and correct defects as required to put systems in perfect operating conditions. Work shall include furnishing instruments, materials and the cost of replacement and repairs of damage due to failure under test.

B. After the installation of the 120/240 or 277/480 volt service and feeder conductors is complete, prior to energizing them test each conductor with a 600 volt meter. Provide all conductors to be free from short circuits and from grounds other than as provided in Article 250 or the National Electrical Code.

C. Record feeder load currents and line voltages at each panelboard. Adjust single phase load connections to balance feeder loads. Record load currents of each electrical motor 1/4 H P and larger. Provide the Texas Parks and Wildlife Department (TPWD) Construction Manager with a complete copy of all initial load records.

D. Cable Tests

1. The insulations resistance of all service and feeder conductors shall be tested. Each conductor shall have its insulation resistance tested after its installation is completed and all splices, taps and connections are made except the connections to or into its source and point (or points) of termination.

2. The insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using a Biddle (or written approved equal) megger of not less than 1,000 volts DC. Resistance shall be measured by connecting one terminal of megger to the conductor and the other terminal to the conduit in which the conductor is installed. Readings shall be observed after one minute operation of the megger at slip speed. The
insulation resistance of conductors rated at 600 volts shall be not less than the following for the wire sizes based on Section 6.15 of ICEA-S-66-524:

\[ R = K \log_{10} \frac{D}{d} \]

Where:

- \( R \) = Insulation resistance in megohms – 1,000-feet
- \( (R = 10,000 \text{ for XHHW insulations}) \)
- \( (R = 2,000 \text{ for THHW/THHN insulation}) \)
- \( K \) = Constant for the insulation (see Part 3)
- \( D \) = Diameter over the insulation
- \( d \) = Diameter under the insulation.

3. Conductors that do not equal or exceed the insulation resistance values listed above shall be replaced. The tests shall be performed in the presence of the Texas Parks and Wildlife Department (TPWD) Construction Manager and Owner. The Contractor shall furnish all instruments and personnel required for the tests, shall tabulate the readings observed, and shall forward to the Texas Parks and Wildlife Department (TPWD) Construction Manager two copies of the test readings.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE

PART 3 – EXECUTION

3.1 BALANCING OF ELECTRICAL CIRCUITS

A. The system of feeder and branch circuits for power and lighting shall be connected to panelboard buses in such a manner that loads connected thereto will be balanced on all phases as closely as practicable.

B. Should there be any unfavorable condition of unbalance on any part of the electrical system, the contractor shall make such changes that may be necessary to remedy the unbalanced condition.

C. The Contractor shall provide to the Texas Parks and Wildlife Department (TPWD) Construction Manager a complete list of all panels stating the measured loads on each phase prior to completion of the project.

END OF SECTION 260003
SECTION 260501 - MINOR ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including Uniform General Conditions & Special Conditions, apply to this Section.
B. Section Uniform General Conditions & Special Conditions for Closeout requirements.

1.2 SECTION INCLUDES
A. Electrical demolition.

1.3 SUBMITTALS
A. See Uniform General Conditions & Special Conditions for submittal procedures.
B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT
A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify field measurements and circuiting arrangements are as shown on Drawings.
B. Verify that abandoned wiring and equipment serve only abandoned facilities.
C. Demolition drawings are based on casual field observation and existing record documents.
D. Report discrepancies to Owner before disturbing existing installation.
E. Report discrepancies to Texas Parks and Wildlife Department (TPWD) Construction Manager before disturbing existing installation.
F. Beginning of demolition means installer accepts existing conditions.
3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until demolition is required. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 48 hours in advance.

F. Existing Telephone System: Maintain existing system in service until demolition is required. Minimize outage duration.
   1. Notify Owner at least 48 hours before partially or completely disabling system.
   2. Notify telephone utility company at least 48 hours before partially or completely disabling system.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.
   3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

END OF SECTION 260501
SECTION 260519 - 600-VOLT BUILDING WIRE AND CABLE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specifications for 600-volt building wire and cable.

1.2 REFERENCES


B. Underwriter's Laboratories (UL):
   1. UL 83: Thermoplastic Insulated Wires and Cables
   2. UL 1063: Machine Tool Wires and Cables

C. American Society for Testing and Materials (ASTM):
   1. ASTM B3: Soft or Annealed Copper Wires
   2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

D. Insulated Cable Engineers Association (ICEA) ICEA-S-95-658/NEMA WC70: non-shielded 0-2KV cables, (ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5) is now withdrawn.)

1.3 SUBMITTALS

A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer's cut sheets and catalog data
   2. Instruction for handling and storage
   3. Dimensions and weight
   4. Conformance certificate

1.4 QUALITY ASSURANCE

A. Tests: Cable shall meet all the requirements of ICEA S-95-658/NEMA WC70.

B. Conformance Certificate and Quality Assurance Release: Submit a conformance certificate signed by the person responsible for product quality. The certificate shall specifically identify the purchased material or equipment; such as by the project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. The certificate shall indicate that requirements have been met and identify any approved deviations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.
PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. American Insulated Wire Corporation

B. Carol Cable Company, Inc.

C. General Cable Company

D. Okonite Company

E. Rome Cable Company

F. Triangle Wire and Cable, Inc.

2.2 MATERIALS AND EQUIPMENT

A. Design: Provide cable designated as THWN/THHN or XHHW single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90°C in dry locations and 75°C in wet locations while installed in underground duct, conduit or in control panels (MTW).

B. Conductors: Provide conductors which are Class B, concentric stranded, annealed uncoated copper with physical and electrical properties complying with ASTM B3 and B8 and of ICEA S-95-658/NEMA WC70.

C. Insulation: Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of ICEA S-95-658 WC70. The insulation thickness shall match the dimensions listed in NEC Table 310.13 for type THHN and THWN wire.

D. Wire Marking:

1. Wire marking shall be in accordance with NEC Article 310.11 and shall be printed on the wire insulation at 2-foot intervals.

2. The printing method used shall be permanent and the color shall sharply contrast with the jacket color.

E. The single conductor color coding shall be as follows:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208 Volt 3Ph/4w</td>
<td>Black</td>
<td>Red</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>120/240 Volt 3Ph/4w</td>
<td>Black</td>
<td>Orange</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>277/480 Volt 3Ph/4w</td>
<td>Brown</td>
<td>Purple</td>
<td>Yellow</td>
<td>Grey</td>
</tr>
<tr>
<td>Motor Control</td>
<td>1</td>
<td>Black</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground</td>
<td></td>
<td></td>
<td></td>
<td>Green</td>
</tr>
</tbody>
</table>
PART 3 – EXECUTION

3.1 PREPARATION

A. Complete the cable raceway systems and underground duct banks before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Clean conduits of foreign matter before cables are pulled.

3.2 INSTALLATION

A. Wiring Methods:

1. Use wiring methods indicated on the Drawings.

2. In general, use THHN/THWN or XHHW building wire for lighting, power and control wiring, where conductors are enclosed in raceways such as above ground conduit system, underground duct banks, or inside control panels.

3. Do not use solid conductors.

4. Use conductors not smaller than No. 12 AWG stranded for lighting circuits.

5. Use conductors not smaller than No. 14 AWG for control circuits, except when part of a multiconductor cable or internal panel wiring.

6. In general, do not splice conductors unless approved by the Texas Parks and Wildlife Department (TPWD) Construction Manager.

7. Splices associated with taps for lighting and control circuits are allowed without approval.

8. Make splices in accessible junction boxes.


B. Single Conductor in Conduit and Ductbank:

1. Install cables in accordance with the manufacturer’s instructions and NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.

2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.

C. Preparation for Termination:

1. Terminal lugs and connectors on busbars for all sizes of conductors shall be compression crimp-on type.

2. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole compression crimp-on type except in places where termination space is limited.

D. Tests:

1. In general, test insulation integrity of the wiring system before terminating.

2. Make sure to disconnect sensitive electronic equipment before testing insulation.

3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.

E. Termination: After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION 260519
SECTION 260526 - GROUNDING AND BONDING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors
B. Equipment grounding conductors
C. Bonding
D. Power system grounding
E. Communication system grounding
F. Electrical equipment and raceway grounding and bonding
G. Control equipment grounding

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM B3: Soft or Annealed Copper Wires
   2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
   3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes

B. Institute of Electrical and Electronics Engineers (IEEE)

C. Underwriters' Laboratories (UL)
   1. UL 83: Thermoplastic Insulated Wire and Cables
   2. UL 467: Grounding and Bonding Equipment


1.3 SUBMITTALS

A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer’s cut sheets and catalog data
   2. Installation, terminating and splicing procedure
3. Instruction for handling and storage
4. Dimensions and weight

1.4 QUALITY ASSURANCE

A. Tests
1. Use insulated cable conforming to requirements of the vertical tray flame test as described in IEEE 383-2003.
2. Test grounding system in the field in accordance with procedures outlined in Part 3, Execution.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ship grounding cable on manufacturer’s standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Pack and crate other materials specified to withstand normal abuse during shipping, handling and storage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cable
1. American Insulated Wire Company
2. Cablec Continental Cables Company
3. General Cable Company
4. Okonite Company
5. Pirelli Cable Corporation
6. Rome Cable Corporation
7. Triangle Wire and Cable, Inc.

B. Ground Rods and Connectors:
1. Blackburn
2. Copperweld
3. Thomas and Betts

C. Exothermic Connections:
1. Burndy Corporation (Therm-O-Weld)
2. Erico Products (Cadweld)

D. Grounding Connectors:
1. Burndy Corporation
2. O.Z. Gedney
3. Thomas and Betts
2.2 MATERIALS AND EQUIPMENT

A. Design. Provide grounding cable and materials with the following characteristics:

1. Use a grounding system designed in accordance with NEC Article No. 250 - Grounding, and the IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

2. In areas enclosed by metal fencing, install a #4/0 ground loop encompassing these areas to facilitate the grounding of electrical power distribution and lighting equipment and bonding of associated metal enclosures, equipment, buildings and fencing.

B. Materials

1. Use grounding conductors, bare or insulated, which are manufactured and tested in accordance with applicable standards ASTM B3, ASTM B8 and ASTM B33.

2. Provide a main ground loop of No. 4/0, Class C stranded, bare copper cable. Small groups of isolated equipment may be grounded by a No. 2 AWG minimum insulated conductor connected to the main loop. Generally, taps shall be sized as follows:

   a. Main ground loop or grid #4/0
   b. Main Switchgear to Ground Bus #4/0
   c. Motor control centers and power transformers #4/0
   d. Motors 200 HP and above #4/0
   e. Power panels - AC and DC #2/0
   f. Control panels and consoles #2/0
   g. Building columns #4/0
   h. Fencing posts #2/0

3. Where single conductor insulated grounding conductors are called for, use 600-volt insulation. Use ground conductors identified with green insulation or green tape marking.

4. Supply identifying ribbon which is PVC tape, 3 inches wide, red color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters as specified in Section 260553, Electrical Identification.

5. Utilize flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

PART 3 – EXECUTION

3.1 PREPARATION

A. Complete site preparation and soil compaction before trenching and driving ground rods for the underground grid.

B. Confirm the exact location of stub-up points for grounding of equipment, fences and building or steel structures.
3.2 CONSTRUCTION CRITERIA

A. Install the main ground loop at a depth of at least 30-inches below earth surface. Connect the ground loop to ground rods and to tap connections to form a complete system as indicated on the electrical Drawings and as stated herein. The Contractor shall give special attention to the grounding of service equipment, structures and fences to comply with the NEC, local authorities and the serving utility company.

B. Electrical equipment, buildings, tanks, and other structures and equipment shall be grounded as detailed. Where ground rods are required, the rods shall be 10-feet long, 3/4-inch diameter, copper-clad steel ground rods. Rods shall be driven vertically, and the top of the rods shall be a minimum of 18-inches below finished grade, or as specified on the Drawings.

C. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panelboards, operator panels, benchboards, and the enclosures of other electrical apparatus shall be grounded through and equipment grounding conductor run with the power supply or control circuit conductors or shall be grounded as shown on the Drawings.

D. Ground medium voltage motors, in addition to the grounding conductors in the motor feeder cable, with a separate No. 2 AWG cable to motor frame.

E. Motors having power supplied by multiconductor cable shall be grounded by a separate grounding conductor in the cable and where supplied by single conductor cable in conduit by a grounding conductor pulled in the conduit. Connect ground conductors to the ground bus in the motor control center and to the ground terminal provided in the motor conduit box.

F. Do not ground the insulated bearing pedestals of large motors.

G. Connect ladder-type cable trays to the grounding electrode system.

H. Install a warning ribbon approximately 12-inches below finished grade directly above the ground grid.

I. Connect fence posts of chain link and metal fences to the ground rod at least every 50-feet.

3.3 INSTALLATION

A. Equipment Grounding

1. Make grounding connections to surfaces which are dry and cleaned of paint, rust, oxides, scales, grease and dirt to ensure good conductivity. Clean copper and galvanized steel to remove oxide before making welds or connections.

2. Use the exothermic welding process for below-grade grounding connections, except at ground rods. Use mechanical connectors or thermal connections for above-grade grounding connections as shown on the Drawings.

3. Make grounding connections to electrical equipment, vessels, mechanical equipment and ground rods in accordance with the Drawings.

4. Ground tanks and vessels by making connections to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel.

5. Leave ground connections to equipment visible for inspection. Protect them with PVC non-metallic conduit as detailed.
6. Make connections to motor frames and ground buses with lugs attached to the equipment by means of bolts. Do not use motor anchor bolts or equipment housing for fastening lugs of grounding cable.

7. Where the wiring for lighting systems consists of single conductor cables in conduit, provide each conduit with an equipment grounding conductor. Use a grounding conductor with green colored insulation and ground equipment in the lighting system.

B. Raceway and Support Systems Grounding

1. Install raceway, cable rack or tray and conduit so that it is bonded together and permanently grounded to the equipment ground bus, according to the Drawings. Connection to conduit may be grounding bushing or ground clamp.
2. Install raceway at low voltage motor control centers or other low voltage control equipment so that it is bonded and grounded, except that any conduit which is effectively grounded to the sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.
3. Where a grounding conductor is run in or on a cable tray, bond the grounding conductor to each section of cable tray with a cable tray ground clamp.
4. Where only grounding conductor is installed in a metal conduit, bond both ends of the conduit to the grounding conductor.
5. Provide flexible "jumpers" around raceway expansion joints. Use copper bonding straps for steel conduit. Install jumpers across cable tray joints which have been parted to allow for expansion and any hinged cable tray connections.

C. Fences and Gates. Ground fences, fence posts, gate posts and gates to an underground grid or loop as described in Section 2.2 A&B of this Specification Section.

D. Power System Grounding

1. Solidly ground and bond neutral in service disconnect switch.
2. Solidly ground the secondary neutral of the main power supply transformer either to the ground grid or through #4/0 ground loop. See Drawings for additional details.
3. Solidly ground the panelboards as required by N.E.C.-250 and local code to #4/0 ground loop.
4. Solidly ground the neutral of lighting, instrument and control transformers.

E. Cable Armor and Shields

1. For shielded control cable, terminate and ground the shield at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.
2. Connect the ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not carry these ground wires through a "doughnut" current transformer (CT) used for ground fault relaying; do carry ground leads from stress cones through CTs. Ground power cable armor and shield at each terminal point.

F. Test Wells

1. Provide access (test wells) for testing the ground grid system at one or several ground rod locations. Make test wells of a pipe surrounding the rod and connections with a cover placed on top at grade level. See Drawings for additional details.
2. Install a test well at the service entrance pole to serve as the service entrance grounding electrode.
G. Test

1. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable Drawings.

2. Make tests at each ground test well using a “fall of potential” test method. Each ground test well shall not exceed a maximum resistance of 5 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit.

H. Inspection. Inspection of the grounding system by the Texas Parks and Wildlife Department (TPWD) Construction Manager and the local Code Inspector must take place before the grid trenches are backfilled.

END OF SECTION 260526
SECTION 260529 - SUPPORTING DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES
   A. Conduit and equipment supports.
   B. Anchors and fasteners.

1.2 REFERENCES
   A. NECA (National Electrical Contractors Association.) Standard of Installation.

1.3 SUBMITTALS
   A. Submit under provisions of Uniform General Conditions & Special Conditions.
   B. Product Data: Provide manufacturer’s catalog data for fastening systems.
   C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 REGULATORY REQUIREMENTS
   A. Conform to requirements of ANSI/NFPA 70.
   B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 – PRODUCTS

2.1 PRODUCT REQUIREMENTS
   A. Materials and Finishes: Provide adequate corrosion resistance.
   B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
   C. Anchors and Fasteners:
      1. Concrete Structural Elements: Use precast insert system, expansion anchors, and preset inserts.
      2. Steel structural elements: Use beam clamps, spring steel clips, and welded fasteners.
5. Solid Masonry Walls: Use expansion anchors and preset inserts.

2.2 STEEL CHANNEL

A. Manufacturer:
   1. Unistut.
   2. B-Line.

B. Description: Hot dipped galvanized steel.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit. Do not depend on drywall for support. Mount backing to studs.

D. Obtain permission from Texas Parks and Wildlife Department (TPWD) Construction Manager before drilling or cutting structural members.

E. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

F. Install surface-mounted cabinets and panelboards with minimum of four anchors.

G. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 260529
SECTON 260533 - CONDUIT, FITTINGS AND BODIES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specification for conduit, fittings and bodies.

1.2 REFERENCES

A. American National Standards Institute (ANSI).

1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated.
2. ANSI C80.4: Fittings for Rigid Metal Conduit.

B. Federal Specifications.

1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.
3. WW-C-566C: Flexible Metal Conduit.
4. WW-C-581D: Coatings on Steel Conduit.

C. National Electrical Manufacturers Association (NEMA).

1. NEMA RN1: Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.


E. Underwriters’ Laboratories (UL).

1. UL 1: Flexible Metal Conduit.
2. UL 6: Electrical Rigid Metal Conduit - Steel.
3. UL467: Grounding and Bonding Equipment.
4. UL 514B: Conduit, Tubing and Cable Fittings.
5. UL 651: Schedule 40 and 80 Rigid PVC Conduit and Fittings.
6. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.
7. UL797: Electrical Metallic Tubing - Steel.
8. UL 886: Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
9. UL1653: Electrical Nonmetallic Tubing.

1.3 SUBMITTALS

A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:

1. Manufacturer’s cut sheets, catalog data, with selected products clearly marked.
2. Installation, terminating and splicing procedure.
3. Instruction for handling and storage.
4. Dimensions and weight.
6. Conformance certificate.

1.4 QUALITY ASSURANCE

A. Tests:
   1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1.
   2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.
   3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A.

1.5 DELIVERY STORAGE AND HANDLING

A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.

B. Store conduit above ground on racks to prevent corrosion and entrance of debris.

C. Protect plastic conduit from sunlight.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Rigid Steel Conduit:
   1. Allied Tube and Conduit
   2. Triangle Wire and Cable, Inc.
   3. Wheatland Tube Company

B. Electrical Metallic Tubing (EMT):
   1. Allied
   2. E.T.P
   3. Republic or written approved equal

C. Electrical Nonmetallic Tubing (ENT): Carlon

D. Flexible Metal Conduit:
   1. Appleton
   2. Crouse-Hinds
   3. Raco
   4. Steel City or written approved equal
E. Liquid Tight Flexible Conduit:
   1. Anamet, Inc.
   2. Electriflex Company
   3. Triangle Wire and Cable, Inc.

F. PVC Coated Steel Conduit:
   1. Occidental Coating Company (O-Cal Blue)
   2. Robroy Industries, Inc. (Rob-Roy Red)

G. PVC Rigid Conduit:
   1. Cantex
   2. Carlon Industries, Inc.
   3. Robroy Industries, Inc.
   4. Triangle.

H. Conduit Fittings and Bodies:
   1. Appleton Electric
   2. Crouse-Hinds
   3. Killark Electric Manufacturing Company
   4. O-Z/Gedney
   5. Raco
   6. Steel City.

2.2 MATERIALS AND EQUIPMENT

A. Design Conditions: Use electrical conduit, fittings, and bodies designed for service in areas as specified in Section 260000, General Provisions for Electrical Work and this section to form a continuous support system for power, control, and instrument cables.

B. Conduit and Fittings:

   1. Rigid Steel Conduit and Fittings.
      a. Conduit: Hot-dip galvanized rigid steel conduit (RSC) with zinc-coated threads and an outer coating of zinc chromate.
      b. Fittings: Threaded, malleable iron, either cadmium plated or hot-dip galvanized.
      c. Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dip galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581D, and NEC Article 344.
      d. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.
      e. Fittings, bodies, and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C.

   2. Electric Metallic Tubing:
      a. Conduit: Galvanized electrical steel tubing.
      b. Fittings: Compression type, malleable iron either cadmium plated or hot-dip galvanized
      c. EMT, with compression fittings, can be used in the "office area" only balance of the building shall be rigid of galvanized steel.
3. Flexible Metal Conduit: Use flexible conduit to all recessed lighting fixtures within 6-feet maximum. Also, to all motors inside the building for motor connections exposed to the weather, use liquid-tight. Maximum length of flex to motors is three (3) feet.
   b. Fittings: Two-screw, double-clamp malleable iron, either cadmium plated or hot-dip galvanized steel.

4. Flexible and Liquid-tight Flexible Metal Conduit and Fittings:
   a. Use liquid-tight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C.
   b. Fittings used with liquid-tight flexible metal conduit shall be the PVC-coated type and of such design as to thoroughly ground the conduit to the fittings, and through it to the box or enclosure to which it is attached.
   c. Flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501.140 (A) and (B) and Federal Specification W-C-586C.
   d. Conduit: Spiral-wound, square-locked, hot-dip galvanized steel strip plus a bonded outer jacket of PVC.
   e. Fittings: Compression type, malleable iron, with insulated throat, either cadmium plated or hot-dipped galvanized.

5. PVC Conduit and Fittings: Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-A, and NEC Article 352.100 and 352.120 for underground installation. Conduit shall be schedule 80. When crossing under the streets, conduits shall be PVC conduit Schedule 80.

6. Polyvinyl Chloride Conduit (PVC):
   a. Conduit: Schedule 80 heavy wall.
   b. Fittings: Schedule 40 PVC.
   c. Adapters: Threaded for transition to rigid steel elbows.
   d. Acceptable Conduit and Fittings Manufacturers: Carlon, Triangle or written approved equal.

7. Electrical Nonmetallic Tubing (ENT):
   a. Fitting and outlet boxes shall be designed for use with ENT and listed by Underwriters Laboratories.
   b. Only Carlon ENT Blue cement recommended for use with ENT shall be used.

PART 3 – EXECUTION

3.1 PREPARATION

A. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types and routing shown.
B. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.
C. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.

D. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

### 3.2 INSTALLATION

A. Install PVC-coated conduits in all outdoor locations; inside valve vaults; in wet well slabs; and in corrosive and wet environments.

B. Install rigid galvanized steel (RGS) conduits in dry inside locations only. Rigid Galvanized Steel conduit shall be used below 8-feet-0-inches in areas subject to physical damage.

C. Install Electrical Metallic Tubing (EMT) in exposed areas above 8-feet-0-inches or in concealed areas as permitted by NEC Section 358. EMT shall not be buried in ground or embedded in concrete.

D. Install Electrical Nonmetallic Tubing (ENT) in concrete as permitted by NEC Section 362.

E. Install PVC conduits in duct banks. For stub-ups, use PVC-coated rigid steel elbows and risers.

F. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal operating and maintenance procedures. Maintain a minimum overhead clearance of 8-feet-0-inches in passageways.

G. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed.

H. Identify conduit at termination points like switchboards, panelboards, MCC, light fixtures, control panels, receptacles, and junction boxes.

I. Not more than 3 equivalent 90° bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

J. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight.

K. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials.
L. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks.

M. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

N. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.

O. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign matter into the conduit system by properly capping terminations. To prevent water or other liquids from running out of a cable duct and entering a manhole, central office or in ground fixtures, use 3M Duct Sealing Kit 4416 or equivalent product recommended by the manufacturer at both ends of a conduit. In fountain area use 3M Scotchcast 2135 Wet Niche Potting Compound or equivalent product recommended by the manufacturer.

P. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" conduit equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20°F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.

Q. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.

R. Where conduit terminates in sheet metal enclosures and where no threaded hubs are provided, fit the conduit with double locknuts and bushings. Sheet metal enclosures located outside or in any other wet, damp or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure.

S. Provide flexible metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment unless shown otherwise on Drawings.

T. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the Drawings.

U. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well.

V. Unless otherwise indicated on the Drawings, install expansion fittings every 300-feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.

W. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12-inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.

X. Fill conduit racks no more than 75% of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future
conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

Y. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.

Z. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200-feet along the entire length of the conduit.

AA. Support conduit sizes 2-inches and larger at spacings not exceeding 10-feet and conduit sizes 1-1/2-inches and smaller at spacings not exceeding 8-feet.

BB. The means of fastening conduit to supports shall be: By one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.

CC. Support conduit runs with conduit clamps, hangers, straps and metal framing channel attached to structural steel members. Conduits of 1-1/2-inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 3/16 stainless steel.

DD. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

EE. EMT shall be run inside walls. BX flex is not allowed to feed switch legs, convenience outlets and similar devices. Control wiring for HVAC system to be run in EMT.

FF. Conceal conduit in walls or above ceiling in all finished spaces.

GG. Both underground and exposed conduit systems shall be installed watertight. Test with 5 PSI air pressure without leakage for ten (10) minutes before installing wires.
SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specification for electrical identification including:
   1. Nameplates and labels
   2. Wire and cable markers
   3. Conduit markers
   4. Cable tray markers
   5. Underground warning tape
   6. Warning labels

1.2 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC)
   1. Article 110 - Requirements for Electrical Installation
   2. Article 450 - Transformers and Transformer Vaults

B. Other applicable Codes and Standards as referenced in other Sections.

C. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.3 SUBMITTALS

A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer's cut sheets and catalog data
   2. Description of materials used
   3. Label or nameplate dimensions
   4. Engraving or imprint legends
   5. Instruction for handling and storage
   6. Installation instructions

1.4 DELIVERY, STORAGE AND HANDLING

A. Pack materials to permit ease of handling and to provide protection from damage during shipping, handling and storage.
PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Almetek Industries Incorporated
B. Brady U.S.A. Incorporated
C. Ideal Electric Company
D. Raychem Corporation
E. 3M Electrical Products Division
F. Thomas and Betts
G. Tyton Corporation

2.2 MATERIALS AND EQUIPMENT
A. Nameplates and Labels

1. Provide an identification tag for each item of electrical equipment showing its item number and service or application. Use the description shown on the electrical Drawings.
2. For standard nameplates used for general park equipment and restaurants, use 3-ply phenolic material engraved to show white lettering on black background. Size the nameplates approximately 1-inch wide and 3-inches long for 3 lines of 3/16-inch – 16 letters with a 0.8 condensed factor. For garage equipment such as panelboards, switchboards, transformers, etc., provide a nameplate with ½-inch white lettering on red background. The garage equipment nameplates shall be approximately 8-inches wide and 10-inches long.
3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical equipment, device or enclosure not furnished with readily noticeable tag, nameplates or other means of identification.
4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, switchboards, the panelboards, motor control centers, transformers, controllers and the drawing number on which the transformer schematic is shown.
5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1-inch x 3-inch plastic nameplates stating description of item served ("FED FROM" if not readily evident).
6. Provide nameplates for motors giving the driven equipment description, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.
7. Install nameplates on the doors of circuit breaker panelboards (i.e., lighting, instrument or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. and compartment).
8. Type panelboard directories and insert them inside the panelboard doors.
9. Place a large nameplate approximately 3-inches x 1-1/2-inches on control panels, relay panels, junction boxes or enclosures with electrical devices, mounted outside of the enclosure indicating the purpose of the cabinet.
10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.
B. Wire and Cable Markers
   1. Use pre-printed tubular type wire and cable markers.
   2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.
   3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock and flammability.
   4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

C. Conduit Markers
   1. Provide conduit markers made of plastic adhesive tags approximately 2-inches x 1-inch x 19 gage.
   2. Stamp the caption on the tag and have it black filled.
   3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire.

D. Cable Tray Markers
   1. For high visibility and contrast, use cable tray markers that are yellow with black legend.
   2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet and abrasive environment.
   3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.
   4. Size legend characters to 4 inches high on a total marker height of approximately 5-inches, suitable for applying to 6-inch side rails of a cable tray.

E. Underground Warning Tape
   1. Provide warning tape made of 4 mil thick polyolefin film, 3-inches wide, suitable for direct burial and resistant to alkalis, acids and other common soil substances.
   2. Use red tape with black legend printed in permanent ink.

F. Warning Labels
   1. Place OSHA safety labels on enclosures and boxes 100 cu. in. or more containing electrical equipment or terminations.
   2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.
   3. The warning label caption is DANGER - 480 volts or as detailed.
   4. Size labels either 5-inches x 3-1/2-inches or 10-inches x 7-inches, or as detailed.

PART 3 – EXECUTION

3.1 PREPARATION
   A. Degrease and clean surfaces where adhesive labels will be applied.
   B. Drill holes for nameplates to be fastened with stainless screws.
   C. Prepare the cable ends for termination and conductor markings.
   D. Identify conduits at terminating points and select tags accordingly.
3.2 INSTALLATION

A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.

B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.

C. Tag conduits at junction boxes, pull boxes and at other termination points.

D. Identify underground conduits, cables or duct banks using the underground warning tape. The underground grounding grid, including the laterals. Also use underground warning tape. Install one tape per trench at 12-inches below grade or as detailed. For wide trenches or duct banks, install one warning tape per 24-inch width.

E. Apply the properly sized warning labels to switchboards, disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the properly sized warning labels to larger control panel enclosures, motor control centers and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION 260553
SECTION 260919 - ENCLOSED CONTACTORS

PART 1 – GENERAL

1.1 SECTION INCLUDES
   A. Specifications for site lighting contactors.

1.2 SUBMITTALS
   A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:
      1. Furnish written verification that contactor type is compatible with all controlling devices.
      2. Indicate enclosure material finish and NEMA classification type.

PART 2 – PRODUCTS

2.1 MANUFACTURERS
   A. Allen-Bradley.
   B. Siemens
   C. General Electric.
   D. Square D.

2.2 ELECTRICALLY HELD CONTACTORS
   A. Electrically held for two-wire control.
   B. Encapsulate coils and rate for continuous duty.

2.3 GENERAL
   A. Coil Operating Voltage: 120 volts, 60 hertz.
   B. Contacts: Provide the number of contacts for the control functions indicated plus two additional contacts, field convertible to normally open or normally closed contacts.
   C. Provide solderless pressure wire terminals.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate controlling devices such as the park lighting control system, time clocks and Photocells with contactor furnished for compatible system.

C. Identify with nameplate. Label each circuit controlled.

END OF SECTION 260919
SECTION 262113 - ELECTRIC SERVICE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for providing electric service.

B. The Contractor shall provide all materials and labor as required to install individual electric service raceways, and service equipment as required.

C. The Contractor shall provide all materials and labor as required to connect and install individual electric service equipment, raceways, and conductors to the project electric service drop.

D. Electric Services for this project shall be extended from the existing CPE service pole and arranged generally as shown on Drawings.

1.2 RELATED WORK

A. Service raceways and risers shall be installed per SECTION 260533 - CONDUIT, FITTINGS AND BODIES.

B. Service conductors shall be installed per SECTION 260519 - 600 - VOLT BUILDING WIRE AND CABLE.

C. Service grounding shall be install per SECTION 260526 - GROUNDING AND BONDING.

D. Enclosed circuit breaker shall be per SECTION 262811 - ENCLOSED CIRCUIT BREAKERS.

1.3 REFERENCES

A. Reference Standard Applicable to this Section:

1. CenterPoint Energy Service Standards.
   a. 70: National Electrical Code (NEC)
3. UL: Underwriters Laboratories
4. NEMA: National Electrical Manufacturers Association

1.4 SUBMITTALS

A. Product Data in accordance with Uniform General Conditions & Special Conditions:

1. Submit manufacturer’s technical product data for enclosures and circuit breakers.
PART 2 – PRODUCTS

2.1 MATERIALS
   A. Electric Service equipment shall comply with NFPA 70 (NEC), shall be UL listed and labeled, and shall be installed per the requirements of CenterPoint Energy and the City of Galveston Electrical Code.

2.2 METERING EQUIPMENT
   A. Service meters shall be installed by the Contractor per CenterPoint Energy requirements.

2.3 CIRCUIT BREAKERS
   A. Service main disconnect Circuit Breakers shall be molded case type with trip indication. All units shall have the frame and trip rating as indicated on the drawings. All units shall have a short circuit interrupt rating greater than the available fault current of the service provided by CenterPoint Energy.
   B. Manufacturers: Subject to compliance with requirements, shall be by one of the following:
      1. Square D
      2. General Electric
      3. ITE
      4. Approved equal

PART 3 – EXECUTION

3.1 INSTALLATION
   A. Install service equipment as shown on the drawings, in compliance with NEC, CenterPoint Energy requirements, City of Galveston Electrical Code, and in accordance with manufacturer’s written instructions.
   B. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
   C. Secure boxes and metering equipment rigidly to the structure upon which they are mounted.

END OF SECTION 262113
SECTION 262213 - DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for dry-type transformers for the following applications:
   1. Motor drive isolation
   2. Shielded isolation
   3. Non-linear loads
   4. General purpose

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
   1. ANSI No. C89.2: Transformers
   2. NEMA ST 1: Specialty Transformers
   3. NEMA ST-20: Dry-Type Transformers for General Applications


C. American National Standards Institute/National Fire Protection Association ANSI/NFPA):

D. NFPA No. 70 -National Electrical Code (NEC); Article 450 - Transformers and Transformer Vaults.

1.3 SUBMITTALS

A. Submit the following under provisions of Uniform General Conditions & Special Conditions.
   1. Outline dimensions, support points and unit weight.
   2. Electrical characteristics, including impedance and tap configuration.
   3. Insulation type, rated temperature rise, and total insulation system.
   4. Test reports, for transformers 300 KVA and above, indicating losses at 25, 50, 75 and 100 percent rated load and sound levels.
   5. Connection diagrams.
   6. Catalog data.
   7. Operation and maintenance data.

1.4 QUALITY ASSURANCE

1.5 DELIVERY, STORAGE AND HANDLING

A. Have transformers individually packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cutler-Hammer
B. General Electric
C. Square D Company
D. Siemens

2.2 MATERIALS AND EQUIPMENT

A. Use dry-type transformers for lighting system or other general purpose applications, motor drive isolation, shielded isolation and non-linear load requirements.
B. Provide transformers with copper windings.
C. Select transformers designed and constructed in accordance with NEMA ST-1, NEMA ST-20 and the NEC Article 450.
D. For applications up to 30 KVA, use transformers that are encapsulated, non-ventilated type with 115°C temperature rise and 185°C insulation class in stainless steel enclosures.
E. Provide transformers with full capacity winding taps a minimum of two 2-1/2% above and two 2-1/2% below normal voltage.
F. For applications of 30KVA and above use transformers that are the drip-proof ventilated type for indoor mounting only.
G. Use transformers with sound levels in accordance with NEMA ST-20.
H. Basic impulse level (BIL) shall be 10KV for transformers less than 300 KVA, 30KV for transformers 300KVA and larger.
I. Ground core and coil assembly to enclosure by means of a visible flexible copper strap.
J. Provide transformers with lifting eye bolts or brackets.
K. Provide transformer nameplates of stainless steel, marked in accordance with NEC Article 450-11. Fasten nameplate to the transformers with stainless steel screws or rivets.
L. Refer to the one-line diagram or the Drawings for transformer size, volt and wire configuration.
M. Special purpose transformers shall be as follows:

1. Motor drive isolation transformers: designed for 3-phase SCR controlled, variable speed motor voltages with bracing to withstand stresses associated with motor drives.
2. Shielded isolation transformers shall be designed for power inputs to microprocessors and computers that require additional protection from electrical disturbances with the use of grounded electrostatic shielding.
3. Non-linear transformers shall be designed to withstand the heating effects caused by harmonics resulting from non-linear, non-sinusoidal loads. Use K-rated transformers for non-linear loads.
4. Buck-Boost, dry type general purpose transformers shall be used for bucking and boosting voltage. These transformers are employed primarily for bucking and boosting single and three phase circuits by connecting them as auto transformers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify dimensions of housekeeping pads or other support structures to ensure proper fit.

B. Verify raceway and wiring drawings that are prepared for the transformers and check them against the manufacturer's information.

C. Verify that the protective devices planned for the transformers are in accordance with NEC Article 450.

3.2 INSTALLATION

A. Install transformers plumb and level and in accordance with manufacturer's instructions and the NEC Article 450.

B. Use flexible conduit for connection to transformer case. Make conduit connections to side panel of enclosure.

C. Mount transformers on isolation pads as required to isolate transformer noise from buildings or structures.

D. Wire transformer primary and secondary in accordance with the nameplate instructions and the designated voltages as shown on the one-line diagram.

END OF SECTION 262213
SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Specifications for panelboards.

1.2 REFERENCES
A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
   1. NEMA AB1: Molded Case Circuit Breakers
   2. NEMA PB1: Panelboards
   3. NEMA PB1.1: Instruction for Safe Installation, Operation and Maintenance of Panelboards rated 600 volts or less.
   4. NEMA PB2.2: Application Guide for Ground-fault Protective Devices for Equipment

1.3 SUBMITTALS
A. Submit the following under provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer's cut sheets and catalog data
   2. Breaker arrangement
   3. Breaker characteristic curves
   4. Instruction for handling and storage
   5. Installation instructions
   6. Dimensions and weights

1.4 STORAGE AND HANDLING
A. Have panelboards packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Sheet Metal Boxes
   1. Cutler-Hammer Products
   2. General Electric
   3. Siemens Energy and Automation
   4. Square D Company

4.3.2020
100% Construction Documents
2.2 MATERIALS AND EQUIPMENT

A. Basic Requirements
   1. Use panelboards manufactured and tested in accordance with NEMA PB 1.
   2. Provide circuit breakers of industrial grade, manufactured and tested in accordance with NEMA AB 1 and Federal Specification W-C-375.
   3. Do not exceed 42 available single pole branch circuits in any one panelboard.

B. Rating
   1. Voltage rating, current rating, number of phases, number of wires and number of poles are indicated on Drawings.
   2. Branch circuit breaker interrupting capacity shall be minimum 42,000 ampere RMS symmetrical for 240V; 25,000 ampere RMS symmetrical for 480V.

C. Circuit Breakers: Molded case, bolt-on thermal magnetic type with number of poles and trip ratings as shown on the Drawings. Provide ground fault interrupters with trip rating where shown on the Drawings.

D. Bus System
   1. Bus Bars: 98 percent conductivity copper. Provide a solid neutral bar in 4-wire panelboards. Include ground bus in all panels. Provide split-bus panels where shown on Drawings.
   2. Main: Circuit breaker or main lugs only as indicated on the Drawings or as required to meet the current interrupting ratings.

E. Box and Trim
   1. Construction: Code grade steel, ample gutter space, flush door, door in door-cover for over 12-1 pole circuits flush snap latch and lock.
   2. Trim: Surface or flush as required. Enclose panelboards located outdoors, or in other wet and corrosive areas in NEMA 4X weatherproof stainless steel enclosures. Enclose indoor panelboards in a NEMA 1 enclosure with manufacturer's standard gray enamel finish.
   3. Directory: Typed card, with plastic cover in frame on inside of door giving the circuit numbers and the area or equipment served.

F. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Review Drawings to verify that panelboards are correct for the application.

3.2 INSTALLATION
   A. Install the panelboard in accordance with NEMA PB 1.1 and NEC.
   B. Mount panelboards 6'-0" (to top of cabinet) above finished floor or grade.
C. In wet and corrosive areas, including outdoor locations, install panel enclosures on spacers to provide approximately 1/4-inch between back of cabinet and mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

END OF SECTION 262416
SECTION 262716 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for cabinets and enclosures for housing of power panels and controls. Installation shall include electrical service cabinet, foundation and grounding per plans and details.

1.2 REFERENCES

A. National Electrical Manufacturers Association (NEMA).
   1. 250 – Enclosures for Electrical Equipment (1000 volts maximum)
      a. NEMA 1 – General Purpose Enclosures for indoor use intended primarily to prevent accidental contact of personnel with the enclosed apparatus. It is suitable for general-purpose applications indoors where it is not exposed to unusual service conditions.
      b. NEMA 3R – Enclosures for outdoor use primarily to provide a degree of protection against windblown dust, rain, and sleet; undamaged by formation of ice on the enclosure.
      c. NEMA 12 – Enclosures for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids.
      d. NEMA 4, 4X – Enclosures for indoor and outdoor use to provide a degree of protection against windblown dust and rain, and splashing or hose-directed water and external enclosure ice formation. Additionally, these enclosures meet 4x description by providing a degree of protection against corrosion.


C. Underwriters Laboratories (UL), UL 50 – Safety for Cabinets and Boxes.

1.3 SUBMITTALS

A. Submit the following under provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer’s cut sheets, catalog data.
   2. Instruction for handling and storage.
   3. Installation instructions.
   4. Dimensions and weights.
   6. Test report.
   7. Conformance certificate.
1.4 DELIVERY, STORAGE AND HANDLING

A. Have cabinets and enclosures packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The EMF Company
B. Hoffman Industrial Products
C. Pauluhn Electric Manufacturing Company
D. Cooper Crouse-Hinds

2.2 MATERIALS AND EQUIPMENT

A. Electrical Enclosures
   1. Provide stainless steel freestanding enclosures manufactured in accordance with NEMA 4X for outdoor service, to house electrical power distribution and lighting control equipment.
   2. Dimensions and special features are shown on the Drawings. Alternate configurations may be acceptable, if approved by the Texas Parks and Wildlife Department (TPWD) Construction Manager.
   3. Construct enclosures from 12 gauge minimum, type 304 stainless steel with continuously welded seams ground smooth.
   4. Material thickness and bracing requirements shall be determined by the manufacturer to provide the strength required by the standard listed. The bracing shall be provided in such a way as to minimize the protrusion into the wiring and the equipment spaces.
   5. Install the doors with stainless steel continuous hinges, door stops, stainless steel padlock handle and gasket and all stainless steel hardware.
   6. Furnish the door with oil-resistant neoprene gasket attached with oil-resistant adhesive and held in place with stainless steel retaining strips.
   7. Use a single one-door handle that provides a 3-point latching through latch rods and rollers.
   8. Gasketed Overlapping doors may be used instead of a center post.
   9. Provide heavy duty lifting eyes of suitable material.
   10. Fabricate the enclosure with a stud mounted steel panel, coordinate finish with Texas Parks and Wildlife Department (TPWD) Construction Manager.
   11. Include a high impact plastic data pocket in the enclosure.
   12. Provide ground connections on the enclosure to enable grounding of the enclosure with No. 2/0 AWG conductor.

B. Hardware
   1. Mounting Hardware: Stainless steel.
   2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.
2.3 TESTING

A. Test cabinets and enclosures in accordance with UL 50 so unit qualifies for a UL label.

PART 3 – EXECUTION

3.1 PREPARATION

A. Review Drawings and determine how many enclosures of each kind are required and check if supplied quantity is sufficient.

B. Check the mounting pads or foundations for proper mounting dimensions and features, including grounding conductor stub-ups.

3.2 INSTALLATION

A. Enclosures described in this specification may be used in either inside and outside locations, but only above grade.

B. Install enclosures in accordance with NEC Article 312 in locations as indicated on the Drawings.

C. Install enclosures in readily accessible locations to facilitate general operations, wire pulls, maintenance and repair.

D. Plug unused conduit openings.

E. Make conduit connections to the enclosures with watertight conduit connectors.

END OF SECTION 262716
SECTION 262723 - DEVICE, PULL AND JUNCTION BOXES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specifications for device, pull and junction boxes.

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
   1. FB1 - Fittings and Support for Conduits and Cable Assemblies
   2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)


C. Underwriters Laboratories (UL):
   1. 50 - Enclosures for Electrical Equipment
   2. 508 - Industrial Control Equipment
   3. 514B - Fittings for Cable and Conduit
   4. 886 - Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.3 SUBMITTALS

A. Submit the following under provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer's cut sheets, catalog data
   2. Instruction for handling and storage
   3. Installation instructions
   4. Dimensions and weights

1.4 DELIVERY, STORAGE AND HANDLING

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes:
   1. Hoffman Industrial Products
2. Pauluhn Electric Manufacturing Company
3. Hennessy
4. Tanco
5. Tejas
6. Circle A.W.

B. Cast Device Boxes:
1. Appleton Electric Company
2. Crouse-Hinds, Division of Cooper Industries
3. Killark Electric Manufacturing Company

C. Concrete Polymer Ground Boxes:
1. Hubbell, Quazite
2. CRS Systems Corp.

2.2 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes:
1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet area, NEMA 250 and NEC.
2. Provide boxes with a stainless steel continuous hinge, closure hasps and all-stainless steel hardware.
3. Furnish the door with neoprene gasket and provision for padlock.

B. Device Boxes
1. Provide UL approved metal boxes (no plastic allowed) designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC.
2. Supply only boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.

C. Wireways:
1. Provide UL approved, NEMA 3R, metal, weatherproof wireways for wiring as indicated on the Drawings.

D. Hardware:
1. Mounting Hardware: Stainless steel
2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or written approved equal.

E. Concrete Polymer Boxes:
1. Provide UL-approved with a minimum loading of 20 K. Loading shall comply with ANSI/SCTE 77.
2. Provide skid resistant cover with stainless steel bolts.
PART 3 – EXECUTION

3.1 PREPARATION

A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.2 INSTALLATION

A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.

B. Install boxes in accordance with NEC in locations indicated on the Drawings.

C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair.

D. Plug, seal and label unused conduit openings.

E. Make conduit connections to sheet metal boxes with watertight conduit connectors.

END OF SECTION 262723
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for wiring devices including:
   1. Receptacles.
   2. Wall switches.
   3. Wall plates and cover plates.

B. Furnish and install a complete system of wiring devices completely and properly wired including a firm ground connection. All devices shall be installed in outlet boxes of required size and volume.

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
   1. NEMA WD1 - General Requirements Wiring Devices.
   2. NEMA WD6 - Wiring Devices - Dimensional Requirements.

B. American National Standards Institute/National Fire Protection Association (NFPA):
   1. NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 406.

1.3 SUBMITTALS

A. Submit the following under provisions of Uniform General Conditions & Special Conditions:
   1. Product Data: Manufacturer's product literature and specifications including dimensions, weights, certifications and instructions for handling, storage and installation.

1.4 DELIVERY, STORAGE AND HANDLING

A. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling and storage.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices must be suitable for the use intended, and have voltage and current ratings adequate for loads served. All receptacles shall have a grounded pole unless specifically indicated otherwise.
2.2 ACCEPTABLE MANUFACTURERS

A. Bryant Electric
B. Crouse-Hinds, Arrow Hart Division
C. Hubbell Inc. Wiring Devices Division
D. Leviton Manufacturing Company
E. Pass & Seymour/Legrand

2.3 MATERIALS AND EQUIPMENT

A. Standards: Conform to NEMA WD1 for general requirements and NEMA WD6 for dimensional requirements.

B. Manufacture devices to heavy-duty industrial specification grade with gray nylon bodies (orange for isolated-ground receptacles) back and side wiring provisions and green-colored grounding screws. Mount wires under screw or clamp tightened by screw. Stab-lok are not acceptable.

C. Receptacles: (Use specification grade unless noted otherwise)

1. Duplex-type receptacles: Rated 20 amps at 125 volts.
2. Contacts: Brass or phosphor bronze.
3. Receptacle grounding system: Extend to the mounting strap unless isolated ground in indicated or required.
4. GFI or GFCI (ground fault circuit interrupter) receptacles: Provide feed-through type with test and reset button.
5. Wall receptacles shall conform to the type, style and rating indicated on the drawings or specified herein. Heavy-duty receptacles shall be of the single type having capacity to carry the rated load continuously without damage. The grounding contact of all grounding system shall be as required by the National Electrical Code.
6. Duplex convenience outlets shall be flush type, 20 ampere, 125 volt, Hubbell 5352 for standard outlets. Ground fault circuit interrupter duplex convenience outlets, designated GFI on plans, shall be Leviton 7899 or Hubbell GF20.
7. Weatherproof receptacles shall be flush mounted, 20 ampere, 125 volt, Leviton 78991 with 6196-FS cover and FS horizontal box.
8. Waterproof cover for right angle GFCI plugs with ground pin up orientation shall be Leviton # 86593.
9. Floor outlets shall be Hubbell B-2536 box; SA-3925 top and 5342 receptacle, with carpet flange as required.

D. Wall Switches: (Use specification grade unless noted otherwise)

1. Wall switches shall be of the toggle type rated 20 amperes, 120-277 volts, AC rated for both resistive and inductive loads with contacts of Silver cadmium oxide construction to prevent sticking, welding and excessive pitting. Single pole switches shall be Hubbell HBL 1221; double pole switches shall be Hubbell HBL 1222; three-way switches shall be HBL 1223; four-way switches shall be HBL 1224. All other switches shall be furnished as specified on the drawings.
2. Switch plates shall be High Impact Nylon, Hubbell HPS. Where more than one switch occurs at a single location, all switches shall be grouped under one plate and covered by a gang type plate.
3. Switch grouping shall comply with Section 404.8 (B) of the National Electrical Code.
E. Special purpose outlets and switches not covered by the Specifications but noted on the Drawings shall be of the amperage and voltage rating indicated. The outlets and switches shall be Specification Grade of the same quantity as those specified.

F. All receptacles shall be of approved NEMA and ANSI configuration for the voltage and current being used.

G. When equipment only, or Junction Box only, is indicated for equipment, it shall be the responsibility of the Contractor to obtain from the supplier, the complete data as related to the electrical portion of the equipment, including rough-in, mounting height, type of outlet, items furnished by the supplier, etc.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that device boxes are correctly placed.

B. Verify that the correct quantity, size and type of wires are pulled to each device box.

C. Verify that wiring has been checked at both ends.

D. Prepare wire ends for connection to devices.

E. Inspect each wiring device for defects.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on top.

E. Connect wiring device grounding terminal to outlet box with bonding jumper.

F. Connect wiring devices by wrapping conductors clockwise around screw terminals.

G. Install cover plates on switch, receptacle and blank outlets in finished areas. When outlets, dimmer switches are located at desktops, mount horizontal with minimum ½” clearance above desktop.

H. Energize and test devices for proper operation.

END OF SECTION 262726
SECTION 262811 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed circuit breakers.

1.2 REFERENCES

A. NECA (National Electrical Contractors Association) “Standard of Installation.”

B. NEMA AB 1 - Molded Case Circuit Breakers

C. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:

1. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

2. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cutler Hammer.

B. General Electric.

C. Square D Company.

D. Siemens.
2.2 CIRCUIT BREAKER
   A. Molded Case Circuit Breakers: NEMA AB 1, integral thermal and instantaneous magnetic trip in each pole. Provide circuit breaker with high interrupting rating as indicated on Drawing.

2.3 ENCLOSURE
   A. Enclosure: NEMA AB 1, Type 1, freestanding for interior applications and NEMA4X, stainless steel for exterior locations.
   B. Fabricate enclosure from steel.
   C. Finish: Manufacturer's standard.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions on concrete housekeeping pad.
   B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 260529.
   C. Height: 5 feet to operating handle.
   D. Ground and bond enclosed circuit breakers in accordance with Section 260526, Grounding and Bonding.
   E. Provide engraved nameplates under the provisions of Section 260553, Electrical Identification.

3.2 FIELD QUALITY CONTROL
   A. Field inspection and testing will be performed under provisions of Uniform General Conditions & Special Conditions.
   B. Inspect and test each circuit breaker to NEMA AB 1.
   C. Inspect each circuit breaker visually.
   D. Perform several mechanical ON-OFF operations on each circuit breaker.
   E. Verify circuit continuity on each pole in closed position.
   F. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
   G. Include description of testing and results in test report.

END OF SECTION 262811
SECTION 262816 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specifications for disconnect switches including:
   1. Fusible disconnect switches
   2. Non-fusible disconnect switches
   3. Circuit breaker type disconnect switches
   4. Fuses
   5. Circuit breakers

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
   1. NEMA AB1: Molded Case Circuit Breakers
   2. NEMA KS1: Enclosed Switches

B. Underwriters Laboratories (UL)
   1. UL 98: Enclosed and Dead-Front Switches
   2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type
   3. UL 198E: Class R Fuses

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA
   No. 70 - National Electrical Code (NEC) - Switches.

1.3 SUBMITTALS

A. Submit the following under provisions of Uniform General Conditions & Special Conditions:
   1. Manufacturer’s cut sheets and catalog data
   2. Switch internal arrangement
   3. Breaker or fuse characteristic curves
   4. Instructions for handling and storage
   5. Installation instructions
   6. Dimensions and weights

1.4 DELIVERY, STORAGE AND HANDLING

A. Have disconnect switches packed and crated to permit ease of handling and to provide protection
   from damage during shipping, handling and storage.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Disconnect Switches and Circuit Breakers:
   1. Cutler-Hammer Products
   2. General Electric
   3. Siemens Energy and Automation
   4. Square D Company

B. Fuses
   1. Bussman Division, Cooper Industries
   2. Gould Shawmut
   3. Littelfuse Incorporated

2.2 MATERIALS AND EQUIPMENT

A. Disconnect Switches
   1. Characteristics: Horsepower rated, 600-volt, heavy-duty type with an interlocked door, positive quick-make, quick-break mechanism and visible blades.
   2. Use switches and components designed, manufactured and tested in accordance with NEMA AB1, NEMA KS1, UL 98, and NEC.
   3. Enclose switch in a NEMA 12 type enclosure for indoor application and NEMA 4X (type 316 stainless steel) in outdoor locations or other wet or corrosive areas.
   4. Provide switches with provisions for padlocking the operating lever in OFF position and door in closed position.
   5. Select switches having the number of poles and general size conforming to the Drawings.
   6. Conform to fusible, non-fusible or circuit breaker type switch requirements as shown on Drawings or one-line diagrams.
   7. Provide an auxiliary contact, shown on the Drawings.
   8. Select fuses or circuit breakers with current interrupting duty as calculated for the points of switch application or as indicated on the Drawings or one-line diagrams.

B. Fuses. Unless otherwise noted on Drawings, for fuses used in disconnect switches, provide the dual-element, time-delay type with the maximum interrupting rating of 200,000 amperes, conforming to the NEC.

C. Circuit Breakers. When circuit breakers are used in disconnect switches, provide the thermal-magnetic type with current interruption ratings as required at the point of application.

D. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review the Drawings and verify that the disconnect switches are correct for the applications.
B. Make sure that the correct fuses or breakers are being used regarding size and short circuit interrupting capability.

C. Prepare adhesive labels on the inside door of each switch indicating UL fuse class and size or breaker type and size for replacement.

3.2 INSTALLATION

A. Install the disconnect switches in accordance with NEC.

B. Mount switches not to exceed 6’-6” (to top of cabinet) above finished floor or grade.

C. In wet and corrosive areas, including outdoor locations, install switches on spacers to provide a space of approximate 1/4-inch between the back of cabinet and the mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

END OF SECTION 262816
SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:
   1. Engine and engine accessory equipment.
   2. Alternator (generator).
   3. Generator set control system.
   4. Generator set enclosure.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
B. Section 231126 - Facility Liquefied-Petroleum Gas Piping.
C. Section 260526 - Grounding and Bonding.
D. Section 260529 - Supporting Devices.
E. Section 260553 – Electrical Identification.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
C. NEMA MG 1 - Motors and Generators; 2017.
F. NFPA 70 - National Electrical Code: Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
I. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
J. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.


1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
   5. Notify Texas Parks and Wildlife Department (TPWD) Construction Manager of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.5 SUBMITTALS

A. See Uniform General Conditions & Special Conditions for submittal procedures.

B. Product Data: Provide manufacturer’s standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
   1. Include generator set sound level test data.
   2. Include characteristic trip curves for overcurrent protective devices upon request.
   3. Include alternator thermal damage curve upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

E. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

F. Specimen Warranty: Submit sample of manufacturer’s warranty.

G. Evidence of qualifications for installer.

H. Evidence of qualifications for maintenance contractor (if different entity from installer).
I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

J. Manufacturer's factory emissions certification.

K. Manufacturer's certification that products meet or exceed specified requirements.

L. Source quality control test reports.

M. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:
   1. Certified prototype tests.
   2. Torsional vibration compatibility certification.
   3. NFPA 110 compliance certification.
   4. Certified rated load test at rated power factor.

L. Manufacturer's detailed field testing procedures.

M. Field quality control test reports.

N. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

O. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

P. Maintenance contracts.

Q. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

R. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Uniform General Conditions & Special Conditions for product requirements.
   2. Extra Fuses: One of each type and size.
   3. Extra Filter Elements: One of each type, including fuel, oil and air.

1.6 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
   3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
   4. NFPA 30 (Flammable and Combustible Liquids Code).
B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   1. Authorized service facilities located within 100 miles of project site.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.

E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
   1. Contract maintenance office located within 100 miles of project site.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Uniform General Conditions & Special Conditions for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Packaged Engine Generator Set - Basis of Design: Cummins Power Generation Inc. systems as indicated under product description below.
B. Packaged Engine Generator Set - Other Acceptable Manufacturers:
   1. Caterpillar Inc.
   2. Generac Power Systems

D. Substitutions: See Uniform General Conditions & Special Conditions for product requirements.

E. Products other than basis of design are subject to compliance with specified requirements and
   prior approval of Texas Parks and Wildlife Department (TPWD) Construction Manager r. By
   using products other than basis of design, Contractor accepts responsibility for costs associated
   with any necessary modifications to related work, including any design fees.

F. Source Limitations: Furnish engine generator sets and associated components and
   accessories produced by a single manufacturer and obtained from a single supplier.

2.2 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit,
   boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a
   complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:
   1. Application: Standby.
   3. Total System Power Rating: 100kW, standby.

D. Packaged Engine Generator Set:
   3. Voltage: As indicated on drawings.
   4. Main Line Circuit Breaker:
      a. Type: Thermal magnetic.
      b. Trip Rating: Select according to generator set rating.
      c. Features:
         1) Shunt trip.
         2) Auxiliary contacts.

E. Generator Set General Requirements:
   1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
   2. Factory-assembled, with components mounted on suitable base.
   3. List and label engine generator assembly as complying with UL 2200.
   4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power
      factor for three phase voltages and 1.0 power factor for single phase voltages.
5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
   1. Altitude: 50 feet.
   2. Ambient Temperature: Between 20 and 104 degrees F.

G. Starting and Load Acceptance Requirements:
   1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
   2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
   3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
   4. Maximum Load Step: Supports 100 percent of rated load in one step.
      a. Maximum Voltage Deviation with Load Step: 1 percent.
      b. Maximum Frequency Deviation with Load Step: 0.5 percent.

H. Exhaust Emissions Requirements:
   1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
   2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Texas Parks and Wildlife Department (TPWD) Construction Manager. Where such modifications are made, provide field emissions testing as necessary for certification.

I. Sound Level Requirements:
   1. Do not exceed 82 dBA when measured at 23 feet from generator set in free field (no sound barriers) while operating at full load; include manufacturer's sound data with submittals.
   2. Comply with applicable noise level regulations.

2.3 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Gaseous (Spark Ignition):
   1. Fuel Source: Propane/Natural gas.
2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.

3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
   a. Carburetor.
   b. Gas pressure regulators.
   c. Fuel shutoff control valves.
   d. Low gas pressure switches.
   e. Vaporizer (for propane liquid withdrawal).

C. Engine Starting System:

1. System Type: Electric, with DC solenoid-activated starting motor(s).

2. Battery(s):
   a. Battery Type: Lead-acid.
   b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
   c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.


4. Battery Charger:
   a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
   b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
   c. Recognized as complying with UL 1236.
   d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
   e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
   f. Provide alarm output contacts as necessary for alarm indications.

5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D. Engine Speed Control System (Governor):


2. Multiple Engine Generator Sets Operated in Parallel: Provide electronic isochronous governors with automatic load sharing controls.

3. Generator Sets Used with Closed Transition Transfer Switches: Provide electronic isochronous governor with frequency regulation suitable for transfer.

4. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
E. Engine Lubrication System:
   1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
   2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.

F. Engine Cooling System:
   1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
   2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
   3. Ducted Radiators: Where ducted radiator air discharge is to be field-installed, provide suitable radiator duct flange/adapter.
   4. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

G. Engine Air Intake and Exhaust System:
   1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
   2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
   3. Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.4 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:
   1. Exciter Type: Synchronous Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
   2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
   3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
   4. Voltage Regulation (with shunt or PMG excitation): Plus/minus two percent for any constant load from no load to full load.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 1, drip-proof.
F. Total Harmonic Distortion: Not greater than five percent.

G. Alternator Heater: Provide strip heater to prevent moisture condensation on alternator windings.

2.5 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:
   1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
   2. Generator Set Control Functions:
      a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
      c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
      d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
      e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
      f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
      g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.

3. Generator Set Status Indications:
   a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
   b. Current (Amps): For each phase.
   c. Frequency (Hz).
   d. Real power (W/kW).
   e. Reactive power (VAR/kVAR).
   f. Apparent power (VA/kVA).
   g. Power factor.
   h. Duty Level: Actual load as percentage of rated power.
   i. Engine speed (RPM).
   j. Battery voltage (Volts DC).
   k. Engine oil pressure.
   l. Engine coolant temperature.
   m. Engine run time.
   n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:
   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      1) Overcrank (shutdown).
      2) Low coolant temperature (warning).
      3) High coolant temperature (warning).
      4) High coolant temperature (shutdown).
5) Low oil pressure (warning).
6) Low oil pressure (shutdown).
7) Overspeed (shutdown).
8) Low fuel level (warning).
9) Low coolant level (warning/shutdown).
10) Generator control not in automatic mode (warning).
11) High battery voltage (warning).
12) Low cranking voltage (warning).
13) Low battery voltage (warning).
14) Battery charger failure (warning).

b. In addition to NFPA 110 requirements, provide the following protections/indications:

1) High AC voltage (shutdown).
2) Low AC voltage (shutdown).
3) High frequency (shutdown).
4) Low frequency (shutdown).
5) Overcurrent (shutdown).
6) Fuel tank leak (warning), where applicable.

c. Provide contacts for local and remote common alarm.
d. Provide lamp test function that illuminates all indicator lamps.

5. Other Control Panel Features:

a. Event log.
b. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
c. Remote monitoring capability via PC.

C. Remote Annunciator:

1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
2. Generator Set Status Indications:

a. Generator powering load (via position signal from transfer switch).
b. Communication functional.

3. Generator Set Warning/Shutdown Indications:

a. Comply with NFPA 110 for Level 1 systems including but not limited to the following indications:

1) Overcrank (shutdown).
2) Low coolant temperature (warning).
3) High coolant temperature (warning).
4) High coolant temperature (shutdown).
5) Low oil pressure (warning).
6) Low oil pressure (shutdown).
7) Overspeed (shutdown).
8) Low fuel level (warning).
9) Low coolant level (warning/shutdown).
10) Generator control not in automatic mode (warning).
11) High battery voltage (warning).
12) Low cranking voltage (warning).
13) Low battery voltage (warning).
14) Battery charger failure (warning).

b. Provide audible alarm with silence function.
c. Provide lamp test function that illuminates all indicator lamps.

D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

2.6 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.
B. Enclosure Material: Steel or aluminum.
C. Hardware Material: Stainless steel.
D. Color: Manufacturer's standard.
E. Access Doors: Lockable, with all locks keyed alike.
F. Openings: Designed to prevent bird/rodent entry.
G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.
H. Sound Attenuating Enclosures: Line enclosure with non-hydrosopic, self-extinguishing sound-attenuating material.
I. Utilize an upward discharging radiator hood.
J. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.
K. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

2.7 SOURCE QUALITY CONTROL

A. See Uniform General Conditions & Special Conditions for quality requirements.
B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.
C. Generator Set production testing to include, at a minimum:
   1. Operation at rated load and rated power factor.
   2. Single step load pick-up.
   3. Transient and steady state voltage and frequency performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.
C. Verify that rough-ins for field connections are in the proper locations.
D. Verify that mounting surfaces are ready to receive equipment.
E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
D. Arrange equipment to provide minimum clearances and required maintenance access.
E. Unless otherwise indicated, mount generator set on properly sized 6 inch (150 mm) high concrete pad constructed in accordance with Section 033000. Provide suitable vibration isolators, where not factory installed.
F. Provide required support and attachment in accordance with Section 260529.
G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
H. Provide propane gas piping in accordance with Section 231126.
I. Provide duct for cooling air intake/exhaust in accordance with Section 233100.
J. Provide grounding and bonding in accordance with Section 260526.
K. Identify system wiring and components in accordance with Section 260553.
3.3 FIELD QUALITY CONTROL

A. See Uniform General Conditions & Special Conditions for quality requirements.

B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Notify Texas Parks and Wildlife Department (TPWD) Construction Manager at least two weeks prior to scheduled inspections and tests.

D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:
   1. Inspect each system component for damage and defects.
   2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
   3. Check for proper oil and coolant levels.

G. Prepare and start system in accordance with manufacturer's instructions.

H. Perform acceptance test in accordance with NFPA 110.

I. Inspection and testing to include, at a minimum:
   1. Verify compliance with starting and load acceptance requirements.
   2. Verify voltage and frequency; make required adjustments as necessary.
   3. Verify phase sequence.
   4. Verify control system operation, including safety shutdowns.
   5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
   6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test).

J. Provide field emissions testing where necessary for certification.

K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.

L. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.
3.5 CLOSEOUT ACTIVITIES

A. See Uniform General Conditions & Special Conditions for closeout submittals.

B. See Uniform General Conditions & Special Conditions for demonstration and training requirements.

C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner’s personnel on operation, adjustment, and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of four hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

E. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.6 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

3.7 MAINTENANCE

A. See Section 312333 – Trenching and Backfilling; for additional requirements relating to maintenance service.

B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.

D. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 4 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

E. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION 263213
SECTION 265100 - LIGHTING FIXTURES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specification for:
   1. LED lighting fixtures
   2. Pole mounted LED lighting fixtures
   3. Wall mounted LED lighting fixtures
   4. Exit fixtures
   5. Photo cells

1.2 REFERENCES

E. IESNA LM-80-08 IESNA - Approved Method for Measuring Lumen Maintenance of LED Light Sources
F. IESNA TM-21-2011 – Projecting Long Term Lumen Maintenance of LED Light Sources
G. IESNA TM-15-11 – Luminaire Classification System for Outdoor Luminaires
H. UL 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products
I. UL 1598 – Luminaries
J. OSHA 29CFR1910.7 – Luminaires shall be listed by national recognized testing laboratory approved by United Stated Department of Labor, Occupational Safety and Health Administration (OSHA)
K. IEC 60529 – Degrees of Protection by Enclosures (IP Codes)

1.3 SUBMITTALS

A. Submit the following under the provisions of Uniform General Conditions & Special Conditions:
   1. Outline dimensions, support points and unit weight.
   2. Operation and maintenance data.
   3. Complete test report with photometric curves.
4. Storage, handling, and installation recommendation.
5. Connection diagrams.
6. Catalog data.

1.4 QUALITY ASSURANCE

A. Product shall be manufactured to conform to requirements of NEC.
B. Manufacturer Qualifications: Company specializing in manufacturing exterior/interior lighting products with minimum ten years documented experience.
C. Luminaire shall be listed for wet locations, electrical components to be rated IP65 or better as tested by an OSHA NRTL facility.
D. Luminaire shall have locality-appropriate governing mark and/or certification.

1.5 DELIVERY, STORAGE AND HANDLING

A. Have lighting fixtures individually packed to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Bega-US
B. Eaton
C. Holophane Company, Inc.
D. Hubbell Lighting, Inc.
E. Lithonia Lighting
F. Luminaire LED
G. Satco Products, Inc.

2.2 REQUIREMENTS

A. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification.

B. Electrical Requirements
   1. Maximum power consumption shall be +/- 5% when operating between 120 – 277V (or 346V).
   2. Operation Voltage - The luminaire shall operate from a 50 or 60 HZ ±3 HZ AC line over a
voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output. The standard operating voltages are 120 VAC, 277 VAC and 347 VAC.

3. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage.

5. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.

6. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.


C. Luminaires

1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array and electronic driver (power supply) and integral controls as per this specification.

2. Integral Grid Clips required on recessed mounted luminaires along with integral tie wire mounting points.

3. Luminaire to have air removal capability as specified.

4. Each luminaire shall be designed for a minimum operational life of 50,000. Each luminaire shall be designed to operate at an average operating temperature of 25°C.

5. The operating temperature range shall be 0°C to +25°C.

6. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated at the average operating temperature.

7. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.

8. LED Boards shall be suitable for field maintenance or service with quick disconnect plugs from below the ceiling. LED boards shall be upgradeable.

D. Driver

1. Standard, Class 1 constant current electronic drivers with expected life of 100,000 hours with <1% failure rate per applicable standards.

2. Drivers shall offer multiple drive currents, up to 1000 mA, based on the specified luminaire and shall include 530 (Size 0 only) and 700 mA.

3. Driver shall include an automatic thermal fold-back feature, such that if the driver’s temperature rises above its design limit, the driver automatically reduces current to bring itself below temperature limit.

4. All drivers shall be RoHS compliant.

5. Driver shall be UL listed.

6. Maximum stand-by power shall be 0 Watts, excluding control devices.

7. Driver disconnect provided where required to comply with codes.

8. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions.

9. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be able to be replaced from the open door.
E. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer’s maximum junction temperature for the expected life shall not be exceeded at the average operating ambient.
3. The LED manufacturer’s maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.
4. The luminaire shall have an UL IC rating.
5. The Driver manufacturer’s maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

F. Photo Cells

1. Provide a photo cell to control outdoor fixtures unless otherwise indicated on the lighting plans.
2. Use a photo cell that is either the plug-in twist-locking type or the wire-in swivel-top type, both with similar features and operating characteristics.
3. Provide a photo cell that is enclosed in a UV-resistant rain-tight polypropylene housing with the cell being a 0.75 square inch cadmium sulfide surface passivated and a single pole, single throw normally closed bi-metallic switch.

PART 3 - EXECUTION

3.1 PREPARATION

A. Check the types and quantity of fixtures to be mounted in the area to be illuminated and verify that materials are on hand.

B. Pick out the correct bulbs for the fixtures along with the necessary accessories and mounting hardware.

3.2 INSTALLATION

A. Install fixtures in accordance with manufacturer’s instructions, NEC Articles 410, 500 and 700 as applicable, and the Drawings.

B. Wire up fixtures in accordance with the Drawings and ensure proper switching, circuiting and balanced loads, wire in-line fuse per fixture driver.

C. Make sure proper grounding and bonding are provided for fixtures and raceways.

D. Install specified lamps in each fixture.

E. When applicable, aim and adjust fixtures in accordance with directions as indicated on the Drawings.

F. Energize and test fixtures for proper operation.
G. Check the illumination level with a light meter and ensure that sufficient light is reaching areas where tasks are performed and that egress paths are properly illuminated during emergency situations.

END OF SECTION 265100
DIVISION 27  COMMUNICATIONS

SECTION 27 20 00 – DATA COMMUNICATIONS

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Coordinate Requirements with owner consultant.

B. Provide data communication system that includes:
   1. CAT5e data port locations as indicated on Drawings.
   2. Wireless connectivity throughout building.

C. Coordinate scope of system with:
   1. Section 27 30 00 Voice Communications.
   2. Section 27 40 00 Audio-Visual Systems.

D. Special Owner-Architect-Contractor Meeting to verify system scope and performance.

1.2 SUBMITTALS

A. Product Data: For each product provided.

B. Shop Drawings: For system cabling.

PART 2 – PRODUCTS

2.1 ETHERNET SYSTEM

A. Cabling:
   1. CAT5e, shielded type as appropriate for system.
   2. Power over Ethernet, as required for equipment.
   3. Rating: Plenum-rated; otherwise, provide conduit per code.

B. Equipment:
   1. Modem located at existing building. Verify second modem not required.
   2. Router (wireless).
   3. Wireless repeaters as necessary.

C. Trim:
   1. Data ports.
   2. Cover plates to match electrical system.

PART 3 – EXECUTION (Not Used)

END OF SECTION 27 20 00
SECTION 27 30 00 – VOICE COMMUNICATIONS

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS
A. Coordinate Requirements with owner consultant.

B. Provide voice communication system that includes:
   1. CAT5e data port locations as indicated on Drawings for VoIP system.
   2. Hardwired emergency telephone, as required by elevator manufacturer.

C. Coordinate scope of system with:
   1. Section 27 20 00 Data Communications.

D. Special Owner-Architect-Contractor Meeting to verify system scope and performance.

1.2 SUBMITTALS
A. Product Data: For each product provided.

B. Shop Drawings: For system cabling.

PART 2 – PRODUCTS

2.1 VOIP SYSTEM
A. Cabling:
   1. CAT5e, shielded type as appropriate for system.
   2. Power over Ethernet, as required for equipment.
   3. Rating: Plenum-rated; otherwise, provide conduit per code.

B. Equipment:
   1. IP Phones to be provided by Owner.

C. Trim:
   1. Data ports.
   2. Cover plates to match electrical system.

PART 3 – EXECUTION (Not Used)

END OF SECTION 27 30 00
SECTION 27 40 00 – AUDIO-VIDEO SYSTEMS

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Coordinate Requirements with owner consultant.

B. Provide audio-video system that includes:
   1. HDMI connections at each television indicated on Drawings.

C. Coordinate scope of system with:
   1. Section 27 20 00 Data Communications.

D. Special Owner-Architect-Contractor Meeting to verify system scope and performance.

1.2 SUBMITTALS

A. Product Data: For each product provided.

B. Shop Drawings: For system cabling.

PART 2 – PRODUCTS

2.1 AUDIO-VISUAL CONNECTIONS

A. Cabling:
   1. HDMI, type as appropriate for Owner-provided equipment.
   2. Rating: Plenum-rated; otherwise, provide conduit per code.

B. Trim:
   1. Open wall ports for concealed connections.
   2. Cover plates to match electrical system.

PART 3 – EXECUTION (Not Used)

END OF SECTION 27 40 00
DIVISION 28  ELECTRONIC SAFETY AND SECURITY

SECTION 28 30 00 – SECURITY DETECTION, ALARM, AND MONITORING

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Coordinate Requirements with owner consultant.

B. Provide security system that includes:
   1. Video-monitored, remote-controlled access at Front Door (LOBB).
   2. Motion detectors near these exterior doors:
      a. EPOR
      b. SPOR
      c. SERV
      d. FEEB
   3. Third-party monitoring by Owner.

C. Coordinate scope of system with:
   1. Section 27 20 00 Data Communications.

D. Special Owner-Architect-Contractor Meeting to verify system scope and performance.

1.2 SUBMITTALS

A. Product Data: For each product provided.

B. Shop Drawings: For system cabling.

PART 2 – PRODUCTS

2.1 VOIP SYSTEM

A. Cabling:
   1. CAT5e, shielded type as appropriate for system.
   2. Power over Ethernet, as required for equipment.
   3. Rating: Plenum-rated; otherwise, provide conduit per code.
B. Equipment:
   1. Modern located at existing building. Verify second modem not required.
   2. IP Phones to be provided by Owner.

C. Trim:
   1. Data ports.
   2. Cover plates to match electrical system.

2.2 EMERGENCY TELEPHONE SYSTEM

A. RE: Elevator manufacturer’s requirements.

PART 3 – EXECUTION (Not Used)

END OF SECTION 27 30 0
SECTION 283100 - FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Uniform General Conditions & Special Conditions Specification Sections, apply
      to this Section.

1.2 SUMMARY
   A. This Section includes the design and installation of fire alarm systems, including manual
      stations, detectors, signal equipment, controls, and devices.

1.3 DEFINITION
   A. FACP: Fire Alarm Control Panel.
   B. BPSP: Booster Power Supply Panel.

1.4 SYSTEM DESCRIPTION
   A. General: Zoned, noncoded fire-detection and alarm system with manual and automatic alarm
      initiation.
   B. Signal Transmission: Hard wired, using separate individual circuits for each zone of alarm
      initiation and alarm device operation.
   C. Audible Alarm Indication: By sounding of horns and bells or by tone signals on loudspeakers.
   D. Visual Alarm Indication: By xenon-strobe-type units.

1.5 SUBMITTALS
   A. General: Submit each item in this Article according to the Conditions of the Contract and
      Uniform General Conditions & Special Conditions Specification Sections.
   B. Product Data for each type of system component specified including dimensioned plans and
      elevations showing minimum clearances and installed features and devices. Include list of
      materials and Nationally Recognized Testing Laboratory (NRTL)-listing data.
   C. Shop Drawings showing details of graphic annunciator.
   D. Wiring diagrams from manufacturer differentiating clearly between factory- and field-installed
      wiring. Include diagrams for equipment and for system with all terminals and interconnections
      identified. Make all diagrams specific to this Project and distinguish between field and factory
      wiring.
E. System operation description covering this specific Project, including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are unacceptable.

F. Operating instructions for mounting at the FACP and BPSP.

G. Product certificates signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

H. Maintenance data for fire alarm systems to include in the operation and maintenance manual specified in Uniform General Conditions & Special Conditions. Include data for each type of product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

I. Record of field tests of system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced factory-authorized Installer to perform work of this Section.

B. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility of system components.

C. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements for the authorities having jurisdiction.

D. Comply with NFPA 70.

E. Comply with NFPA 72.

F. Listing and Labeling: Provide systems and equipment specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electric Code, Article 100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Notifier; Honeywell International Inc.
2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Include the following system functions and operating features plus those additional functions and features required by the authorities having jurisdiction:

1. Priority of Signals: Accomplish automatic response functions by the first zone initiated. Alarm functions resulting from initiation by the first zone are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.

2. Non-interfering: Zone, power, wire, and supervise the system so a signal on one zone does not prevent the receipt of signals from any other zone. All zones are manually re-settable from the FACP after the initiating device or devices are restored to normal. Systems that require batteries or battery back-up for the programming function are unacceptable.

3. Fire Alarm Control Panel (FACP) Response: The manual or automatic operation of an alarm-initiating or supervisory-operating device causes the FACP to transmit an appropriate signal including the following:
   a. General alarm.
   b. Fire-suppression system operation alarm.
   c. Smoke or heat detector alarm.
   d. Valve tamper supervisory.

4. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.

5. Silencing at the FACP: Switches provide capability for acknowledgment of alarm, supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light a light-emitting diode (LED). Subsequent zone alarms cause the audible signal to sound again until silenced by switch operation. Restoring alarm, supervisory, and trouble conditions to normal extinguishes the associated LED and causes the audible signal to sound again until restoration is acknowledged by switch operation.

6. Loss of primary power sounds a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on an alternate power supply.

7. Annunciation: Manual and automatic operation of alarm-and supervisory-initiating devices are annunciated both on the FACP and on the annunciator, indicating location and type of device.

8. General Alarm: A system general alarm includes the following:
   a. Indicating the general alarm condition at the FACP and the annunciator.
   b. Identifying the device that is the source of the alarm (or its zone) at the FACP and the annunciator.
   c. Initiating audible and visible alarm signals throughout the building.
   d. Initiating transmission of alarm signal to remote central station.


10. Water-flow alarm switch operation:
   a. Initiates a general alarm.
   b. Causes flashing of the device location-indicating lamp for the device that has operated.
11. Smoke detection initiates a general alarm.
12. Sprinkler valve tamper switch operation causes or initiates the following:
   
a. A supervisory, audible, and visible “valve tamper” signal indication at the FACP and the annunciator.
b. The location-indicating light to flash for the device that has operated.

2.3 MANUAL PULL STATIONS

A. Description: Double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions for contrasting color.
   
1. Break-Glass Feature: Stations requiring the breaking of a glass panel are unacceptable. Stations requiring the breaking of a concealed glass rod are acceptable.
2. Station Reset: Key or wrench operated, double pole, double throw, switch rated for the voltage and current at which it operates. Stations have screw terminals for connections.

2.4 SMOKE DETECTORS

A. General: Comply with UL 268. Include the following features:
   
1. Factory Nameplate: Serial number and type identification.
2. Operating Voltage: 24-V dc, nominal.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Plug-in Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
5. Integral Visual Indicating Light: Connect to indicate detector has operated.
6. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.

B. Ionization-Type Smoke Detector: Multiple-chamber type operating on the ionization principle and actuated by the presence of invisible products of combustion.

C. Duct Smoke Detector: Ionization type.
   
1. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied.
2. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 OTHER DETECTORS

A. Heat Detector: Combination fixed-temperature and rate-of-rise unit with mounting plate arranged for outlet box mounting; 135 def F fixed-temperature setting, except as indicated.
2.6 ALARM-INDICATING DEVICES

A. General: Equip alarm-indicating devices for mounting as indicated. Provide terminal blocks for system connections.

B. Horns: Electric-vibrating-polarized type, operating on 24-V dc, with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet from the source.

C. Visual Alarm Devices: Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.
   1. Devices have a minimum light output of 115 candela.
   2. Strobe Leads: Factory connected to screw terminals.
   3. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.

D. Voice/Tone Speakers: Comply with UL 1480.
   1. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
   2. High-Range Speaker Units: Rated 2 to 15 W.
   3. Low-Range Speaker Units: Rated 1 to 2 W.
   4. Speaker Mounting: Flush, semirecessed, surface, or surface-mounted bidirectional as indicated.

2.7 CENTRAL FIRE ALARM CONTROL PANEL (FACP)

A. General: Comply with UL 864.

B. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels and field wiring. Identify each enclosure by an engraved, red laminated, phenolic-resin nameplate. Lettering on the enclosure's nameplate shall not be less than 1 inch high. Identify individual components and modules within the cabinets with permanent labels.

C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.

D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.

E. Indicating Lights: Provide individual LED devices for each zone. An LED test switch for each FACP section illuminates all LED devices on that section of the control panel. Manual toggle test switches or push test-buttons do not require a key to operate. Alarm and supervisory signals light a red LED of the associated zone. Trouble signals light an amber LED for the associated zone.
F. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory or trouble signal while the alarm or trouble condition still exists.

2.8 EMERGENCY POWER SUPPLY

A. General: Components include valve-regulated, recombinant lead acid battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years, minimum.

B. General: Components include nickel-cadmium-type battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 20 years, minimum.

C. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (nonalarm) mode for a period of 24 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm or supervisory mode, for a period of 15 minutes.

1. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.

D. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them completely within 4 hours. Charger output is supervised as part of system power supply supervision.

E. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.9 WIRE

A. Wire: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.10 SUPPLY AND INSTALLATION OF EQUIPMENT

A. Provide and install equipment and devices as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system according to NFPA standards referenced in Parts 1 and 2 of this Section.

3.2 EQUIPMENT INSTALLATION

A. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles 48 inches above the finished floor or lower as indicated.
B. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.

C. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches from a side wall to the near edge. Install detectors located on the wall at least 4 inches, but not more than 12 inches, below the ceiling. For exposed solid-joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 60 inches from air registers.

D. Audible Alarm-Indicating Devices: Install not less than 90 inches above the finished floor nor less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.

E. Visual Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and not more than 80 inches above the finished floor and at least 6 inches below the ceiling.

F. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.

G. BPSP: Surface Mount in storage room behind FACP as shown on the drawing. Connect BPSP to FACP.

3.3 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal conduit according to Division 26. Conceal conduit except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Section 26 0000 - General Provisions for Electrical Work.

3.5 GROUNDING

A. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.
3.6 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

B. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

C. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

D. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72. Minimum required tests are as follows:
   1. Verify the absence of unwanted voltages between circuit conductors and ground.
   2. Test all conductors for short circuits using an insulation-testing device.
   3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
   4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
   5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent for the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
   6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
   7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
   8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

E. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

F. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.

G. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.
3.7 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.8 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner’s maintenance personnel as specified below.

1. Train Owner’s maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 4 hours’ training.
2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
3. Schedule training with Owner with at least 7 days’ advance notice.

3.9 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to 3 requested adjustment visits to the site for this purpose.

END OF SECTION 283100
SECTION 311000 – SITE CLEARING

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 SUMMARY

A. This section includes the following:

1. Protecting existing trees to marked to remain.
2. Removing existing trees, shrubs, groundcovers plants and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above and below grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related sections include the following:

1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions TPWD
2. Division 1 Section “Temporary Facilities and Controls” for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and temporary erosion and sedimentation control procedures.
3. Division 31
4. Division 32

1.3 DEFINITION

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from project site.

1.5 SUBMITTALS
A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Division 1 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner’s property will be obtained by Owner before award of contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner’s premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."
   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.
C. Protect existing site improvements to remain from damage during construction.

   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction. A sediment and erosion control plan, specific to the site, which complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

   1. Do not store construction materials, debris, or excavated material within fenced area.
   2. Do not permit vehicles, equipment, or foot traffic within fenced area.
   3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

   1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.4 UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Division 2 Sections covering site utilities.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed sub grade.
   4. Large trees are demolished, the entire stump and root structure shall be removed and backfill shall be installed in the remaining hole and compacted to 95% proctor density. Backfill shall be free and clean of any debris.
   5. Use only hand methods for grubbing within tree protection zone.
   6. Chip removed tree branches dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for respraying deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless the existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000
SECTION 31 23 00 – EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes excavating, filling and backfilling, compacting, grading, and testing for structures, utilities, pavings, and walks.

B. Definitions in this section include the following:

1. Backfill: Soil materials used to fill an excavation.

2. Base Course: Layer placed between the sub-base course and asphalt paving.

3. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

4. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

5. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

   a. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to contract provisions for changes in the work.
   b. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

7. Fill: Soil materials used to raise existing grades.

8. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.

9. Initial Backfill: Portion of trench, backfill that extends vertically from springline of pipe up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

10. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.

11. Omitted

12. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

13. Sub-base Course: Layer placed between the subgrade and a concrete pavement or walk.
14. **Subgrade:** Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.

15. **Trench Zone:** Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

16. **Utilities:** Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

C. **Existing Utilities:** Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

A. **Soil Materials:** Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. **Unsuitable Soils:** ASTM D 2487 soil classification groups ML, CL-ML, MH, OL, OH, and PT, or a combination of these group symbols. Materials that cannot be compacted to the required density due to gradation, plasticity, or moisture content. Materials that contain large clods, aggregates, and stones greater than 4 inches in any dimension, debris, vegetation, and waste, or any other deleterious materials. Materials that are contaminated with hydrocarbons or other chemical contaminants.

C. **Suitable Soil:** Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement are considered suitable, unless otherwise indicated. Suitable material must be free of aggregate greater than 4 inches in any dimension, debris, vegetation and waste, chemical contaminants or any other deleterious materials.

D. **Backfill and Fill:** Suitable soils meeting specified quality requirements placed and compacted under controlled conditions.

E. **Select Backfill:** Class III clayey gravel or sand (GC or SC) or Class IV lean clay (CL) with plasticity index between 7 and 20 or clayey soils treated with lime to meet plasticity criteria and density requirement as per the soil report.

F. **Random Backfill:** Any suitable soil or mixture or soils within Classes I, II, III and IV as per ASTM D 2487 Unified Soil Classification.

G. **Embedment Material:** Soil material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation, 12-inches above top of pipe, including pipe haunching and initial backfill.

1. For water lines embedment, use bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:
a. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
b. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Liquid limit not exceeding 25% and plasticity index not exceeding 7.

2. For sanitary and storm sewer embedment use cement stabilized sand.

H. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base course in paved areas or to the surface grading material in unpaved areas.

1. For water lines, backfill in trench zone, including auger pits, intermediate and site pits with bank run sand or select backfill.
2. For sewer pipes use cement stabilized sand as trench zone backfill under pavement and to within one foot back of curb to a level 12 inches below the pavement.
3. For sewer pipe under natural ground use select backfill in trench zone.

I. Backfill under the Building: Backfill under the building should be as per the soil report.

J. Fill for Site Grading: Fill for site preparation in grade adjustment should be as per the soil report.

K. Sub-base Material: Sub-base material should be as per the soil report.

L. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

M. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

N. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation: Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Provide erosion and sedimentation control measures.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding project site and surrounding area.

D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
E. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

F. Excavate for structures, pavements, and walks to the indicated elevations and dimensions. Extend excavations for placing and removing concrete formwork, for installing services and other construction, and for inspections. Trim bottoms to required lines and grades to leave solid base to receive other work.

G. Excavate utility trenches to indicated gradients, lines, depths, and invert elevations of uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit.

1. Excavate trenches deeper than bottom of pipe elevation, 6-inches deeper in rock, 4-inches deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipe.

H. When wet soil is encountered on trench bottom and dewatering system is not required, over excavate an additional 6 inches. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory type compaction equipment.

I. Proof roll subgrades, before filling or placing aggregate courses, with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

J. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.

K. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

L. Stockpile borrow materials and satisfactory soil materials, without intermixing, in shaped, graded, drained, and covered stockpiles. Stockpile soil materials away from edge of excavations and outside drip line of remaining trees.

M. Utility Trench Backfill: Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.

1. Water Line Embedment Materials:

   a. Maximum 6 inches compacted lift thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698.
2. Sewer Embedment Materials:
   a. Maximum 6 inches compacted lift thickness.
   b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
   c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.

3. Trench Zone Backfill: Cement Stabilized Sand:
   a. Maximum lift thickness determined by contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
   b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
   c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.

4. Bank run sand or select backfill:
   a. Place in maximum 8-inch loose layers.
   b. Compact by equipment providing tamping or kneading impact to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
   c. Moisture content within 2 percent below or 5 percent above optimum determined according to ASTM D 698.

N. Fill: Place and compact fill material in layers to required elevations.

O. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

   1. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

P. Compaction under for fill for other area except utility trenches: Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand operated tampers.

Q. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

   1. Under structures, building slabs, steps, and pavements, scarify and re-compact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent. Fill under precast planks is to be loose un-compacted fill.
   2. Under walkways, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
   3. Under lawn or unpaved areas, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

R. Grading: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Grade lawns, walks, and unpaved subgrades to tolerances of plus or minus 1 inch and pavements and areas within building lines to plus or minus 1/2 inch.
S. Sub-base and Base Courses: Under pavements and walks, place sub-base course on prepared subgrade. Place base course material over sub-base. Compact to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

T. Under slabs-on-grade, place drainage course on prepared subgrade. Compact to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

U. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
   1. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.
   2. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

V. Repair and reestablish grades to the specified tolerances where complete or partially complete surfaces become eroded, rutted, settled, or where they lose compaction.

W. Where settling occurs before project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

X. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312300
SECTION 312301 – CEMENT-STABILIZED SAND

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cement-stabilized sand.

1.2 REFERENCES

C. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.

1.3 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.
B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.3, Materials Qualifications.

1.4 DESIGN REQUIREMENTS

A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.

1. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.

2. Determine minimum cement content from production data and statistical history. Provide no less than 1 ½ sacks of cement per ton of dry sand.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: Type I Portland cement conforming to ASTM C 150.

B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Section 31 23 01 - Utility Backfill Materials, and the following requirements:

1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.

2. Deleterious materials:
   a. Clay lumps, ASTM C 142 - less than 0.5 percent.
   b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
   c. Organic impurities, ASTM C 40, color no darker than standard color.

3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.

C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

A. Add required amount of water and mix thoroughly in pugmill-type mixer.

B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.3 MATERIAL QUALIFICATION

A. Determine target cement content of material as follows:

1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.

2. Complete molding of samples within 4 hours after addition of water.

3. Perform strength tests (average of two specimens) at 48 hours and 7 days.

4. Perform cement content tests on each sample.
5. Perform moisture content tests on each sample.
6. Plot average 48-hour strength vs. cement content.
7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).

B. Test raw sand for following properties at point of entry into pug-mill:
   1. Gradation
   2. Plasticity index
   3. Organic impurities
   4. Clay lumps and friable particles
   5. Lightweight pieces
   6. Moisture content
   7. Classification

C. Present data obtained in format similar to that provided in sample data form attached to this section.

D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:

\[ f'c\% = \frac{1}{2} \text{ standard deviation} \]

PART 3 - EXECUTION

3.1 PLACING

A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is ±3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.

B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01 45 00 - Testing Laboratory Services.

B. One sample of cement-stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement-stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last truck and composite them into one sample for test purpose.

C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.
D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.

F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.

H. Reporting: Test reports shall contain, as a minimum, the following information:
   1. Supplier and plant number
   2. Time material was batched
   3. Time material was sampled
   4. Test age (exact hours)
   5. Average 48-hour strength
   6. Average 7-day strength
   7. Specification section number
   8. Indication of compliance / non-compliance
   9. Mixture identification
   10. Truck and ticket numbers
   11. The time of molding
   12. Moisture content at time of molding
   13. Required strength
   14. Test method designations
   15. Compressive strength data as required by ASTM D 1633
   16. Supplier mixture identification
   17. Specimen diameter and height, in.
   18. Specimen cross-sectional area, sq. in.

3.3 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:
   1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
   2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.4 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.
D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

E. Testing laboratory shall notify Contractor, Project Manager, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.3.A.

G. Cement-stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less that 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.4 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula:

\[
\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2 \times (100 \text{ psi} - \text{Actual psi})}{100}
\]

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to City.

END OF SECTION 312301
SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 Scope:

A. This section provides general requirements for dewatering, or otherwise controlling
   surface water and groundwater to provide suitable conditions for construction of the
   project. The term dewatering as used herein shall mean the removal of either
   groundwater or surface water or both as each specific instance may require.

B. This is a performance specification to design, furnish, install, and operate a dewatering
   system for the control of surface and groundwater during the construction of open cut
   excavations, tunnels, access shafts, structures, and appurtenances.

C. It is the sole responsibility of the Contractor to identify surface and groundwater
   conditions and to provide any and all labor, material, equipment, techniques and methods
   to lower, control and handle the surface water and groundwater as necessary for his
   construction methods and to monitor the effectiveness of this installed system and its
   effect on adjacent facilities.

D. The Contractor is solely responsible for any settlement and/or resultant damage caused
   by the dewatering operation.

E. Contractor shall operate, maintain, and modify the system(s) as required to conform to
   these specifications. Upon completion of the construction, Contractor shall remove the
   system(s) and restore the areas affected to their original conditions. For convenience in
   this section, excavations shall mean both open cut excavating/backfilling and tunneling.

F. The geotechnical information developed for this project is available to the Contractor in
   the office of the Landscape Architect.

G. The development, drilling, and abandonment of all wells used in the dewatering system
   shall comply with Texas Water Commission regulations and the Texas Water Well
   Drillers Associations.

PART 2 - PRODUCTS

2.1 Qualifications:

A. All dewatering systems for tunneling, cut-and-cover excavations, shafts, manholes, and
   structures shall be installed by an experienced and reputable contractor demonstrating
   satisfactory experience in the local area with similar systems.

2.2 Submittals:

A. Submit complete drawings, details and layouts showing the proposed dewatering plans.
   The submittals shall be sufficiently detailed to allow the Engineer to fully evaluate the
   proposed dewatering systems. Include the following as required:

1. Names of equipment suppliers.
2. Names of installation subcontractors.
3. Plans for dewatering at access shafts and control of surface drainage.
4. Plan for dewatering for tunneling and cut-and-cover excavations, or otherwise controlling groundwater.
5. Eductor system layout and details.
6. Deep well locations and details.
7. Well point system layout and details.
8. Installation reports for eductors, deep wells and wellpoints.
9. Water level readings from piezometers.
10. Detailed plans for coffer dams or diversion dams or diversion channel/structures.

PART 3 - EXECUTION

3.1 General Responsibilities of the Contractor:

A. The responsibilities of the Contractor shall specifically include, but not be limited to the following:

1. Obtain all necessary permits from agencies with control over the use of surface water and groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water courses. As the review and permitting process may be lengthy, this condition is brought to the Contractor's attention for early action to pursue and submit for the required approvals, permits and licenses.
2. Take measures to prevent damage to properties, structures, sewers, water mains, and other utility installations, pavements, sidewalks, and work.
3. Modify the system at no cost to the Owner if after installation and while in operation it causes or threatens to cause damage to existing buildings, structures, utilities, or facilities.
4. Monitor the quality of the discharge from the dewatering system to determine if soil particles are being removed by the system.
5. Repair damage, disruption, or interference resulting directly or indirectly from dewatering operations at no cost to the owner and with the Engineer's approval.
6. The system shall be designed to limit the extent of groundwater lowering that would endanger or damage adjacent structures or property, and to safely convey detained or diverted surface waters.
7. The system shall be designed by, and installed under, the supervision of a registered professional engineer in the state of Texas who is experienced in the design, installation, and operation of construction dewatering systems.
8. Design the system to prevent the removal of natural, in-place soils. The system shall be such that after initial development, the quantity and size of soil particles will decrease until no soil particles are present in the water being pumped at any time after 24 hours initial pumping.
9. Do not discharge water from any dewatering operation into the sanitary sewer system.

3.2 Dewatering for Access Shafts, Manholes, Structures, and Cut-and-Cover Construction:

A. Provide means such as ditches, swales, culverts, and grading away from excavations to prevent excessive surface water from entering the excavation. Particular attention should be given to adjacent streets and ditches so that flooding or high water in them will not enter the excavation. The dewatering system shall be designed, constructed, and
operated in such a manner to not cause damage to properties, utilities and other construction.

B. Control the groundwater with well points, eductor systems, deep wells, grout curtains or other means, as necessary, to allow stable excavation.

C. Dewater, or otherwise relieve pressure, in underlying water bearing strata which may cause uplift problems in the excavation bottom.

D. Lower the groundwater level at least 2 feet below the access shaft floor, manhole bottom, structure slab, trench bottom, construction pit low point, or pipe bedding level so that the working area will be dry and firm and so that the utility and structures will be placed on firm ground. Any soil which becomes soft due to standing water or seepage will be removed and replaced with soil compacted to 95% maximum density per ASTM D698, or removed and replaced with other suitable material as approved by the Engineer.

E. Control the seepage and inflow of water into the sides of the excavation to prevent loss of fine sands and silts and settlement around the excavation which may damage adjacent utilities, paving, structures, and properties.

F. Maintain dewatering as required to maintain dry and stable surfaces for placement of concrete, fill or other details included in the construction, and to prevent anticipated uplift condition on the shaft, manhole, cut-and-cover excavation, or other structural excavation. Maintain the dewatering system until any concrete has attained adequate strength for removal of the dewatering system and until the constructed facilities are properly backfilled and protected.

3.3 Measurement and Payment:

A. No separate payment for payment for this item. The costs for this work shall be incidental to utility construction.

END OF SECTION 312319
SECTION 312323.13 - BACKFILL

PART 1 - GENERAL

1.1 Summary:

A. Section Includes

1. Material Classifications
2. Utility Backfill Materials:
   a. Concrete sand
   b. Gem sand
   c. Pea gravel
   d. Crushed stone
   e. Crushed concrete
   f. Bank run sand
   g. Select backfill
   h. Random backfill

B. Material Handling and Quality Control Requirements.

C. Related Sections

1. Trenching and Backfilling – Section 312333

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

1.3 DEFINITIONS:

A. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that are classified as ML, CL-ML, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to the required density due to gradation, plasticity, or moisture content.
3. Materials that contain large clods, aggregate, and stones greater than 4-inches in any dimension; debris, vegetation, and waste; or any other deleterious materials.
4. Materials that are contaminated with hydrocarbons or other chemical Contaminants

B. Suitable Material: Suitable soil materials are the following:

1. Those meeting specification requirements.
2. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement.
C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for the structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

D. Foundation Base: rushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. The foundation base provides a smooth, level-working surface for the construction of the concrete foundation.

E. Backfill Material: Classified soil material meeting specified quality requirements for the designated application as embedment or trench zone backfill.

F. Embedment Material: Soil material placed under controlled conditions within the embedment zone extending vertically upward from top of foundation to an elevation 12-inches above top of pipe, and including pipe bedding, haunching, and initial backfill.

G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in the trench zone from top of embedment zone to base course in paved areas or to the surface grading material in unpaved areas.

H. Foundation: Either suitable soil of the trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

I. Source: A source selected by the Contractor for supply of embedment or trench zone backfill material. A selected source may be the project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

J. Refer to Section 312316.13 – Excavation, Trenching and Backfilling for Utilities for other definitions regarding utility installation by trench construction.

1.4 REFERENCES:

A. ASTM C 33 - Specification for Concrete Aggregate.

B. ASTM C 40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.


H. ASTM D 2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).


L. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.

M. TxDOT Tex-104-E - Test Method for Determination of Liquid Limit of Soils (Part 1)

N. TxDOT Tex-106-E - Test Method - Methods of Calculating Plasticity Index of Soils.

O. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

1.5 SUBMITTALS:

A. Submit a description of source, material classification and product description, production method, and application of backfill materials.

B. Submit test results for samples of off-site backfill materials to comply with Paragraph 2.3, Material Testing.

C. Before stockpiling materials, submit a copy of temporary easement or approval from landowner for stockpiling backfill material on private property.

D. For each delivery of material, provide a delivery ticket that includes source location.

1.6 TESTS:

A. Perform tests of sources for backfill material in accordance with Paragraph 2.3B.

B. Verification tests of backfill materials may be performed by the Owner in accordance with Paragraph 3.3 and the General Conditions.

C. Random fill obtained from the project excavation as source is exempt from pre-qualification requirements by Contractor but must be inspected by Owner's testing lab for unacceptable materials based on ASTM D 2488.

PART 2 - PRODUCTS

2.1 MATERIAL CLASSIFICATIONS:

A. Materials for backfill shall be classified for the purpose of quality control in accordance with the Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.1B, or by product descriptions, as given in Paragraph 2.2.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
   a. Plasticity index: non-plastic
   b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve less than or equal to 5 percent.
2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines
   b. Gradations:
      1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent
      2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
      3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent

3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
   a. Plasticity index: greater than 7.
   b. Gradation: amount passing No. 200 sieve – between 12 percent and 50 percent.

4. Class IVA: Lean clays (CL):
   a. Plasticity Indexes:
      1) Plasticity index: greater than 7, and above A line.
      2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
   b. Liquid limit: less than 50
   c. Gradation: amount passing No. 200 sieve – greater than 50 percent Inorganic.

5. Class IVB: Fat clays (CH):
   a. Plasticity index: above A line.
   b. Liquid limit: 50 or greater.
   c. Gradation: amount passing No. 200 sieve – greater than 50 percent.
   d. Inorganic.

6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to the more restrictive class.

2.2 PRODUCT DESCRIPTIONS:

A. Soils classified as silt (ML), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by the Engineer. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by the applicable backfill installation specification. Refer to Section 312316.13 – Excavation, Trenching and Backfilling for Utilities.

B. Provide backfill material that is free of stones greater than 6-inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:
1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in the product specification, and approved by the Engineer, provided that the physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by the Unified Soil Classification System (ASTM D 2487) meeting the following requirements:

1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM D 1140. The amount of clay lumps or balls not exceeding 2 percent.
2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318:
   a. Liquid limit: not exceeding 25 percent.
   b. Plasticity index: not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C 33 and graded within the following limits when tested in accordance with ASTM C 136:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80 to 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50 to 85</td>
</tr>
<tr>
<td>No. 30</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 50</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 to 10</td>
</tr>
</tbody>
</table>

F. Gem Sand: Sand conforming to the requirements of ASTM C 33 for coarse aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>95 to 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>60 to 80</td>
</tr>
<tr>
<td>No. 8</td>
<td>15 to 40</td>
</tr>
</tbody>
</table>

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>100</td>
</tr>
</tbody>
</table>
H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for the same construction activity from a single source.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have a minimum of 90 percent of the particles retained on the No. 4 sieve with 2 or more crushed faces as determined by Test Method Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from a naturally occurring single source. Uncrushed gravel are not acceptable materials for embedment where crushed stone is shown on the applicable utility embedment drawing details.
6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are the same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as determined in accordance with Tex-110-E.

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing by Weight for Pipe Embedment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;15&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
<td>95 - 100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>60 - 90</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>25 - 60</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>-</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 - 5</td>
</tr>
<tr>
<td>No. 8</td>
<td>-</td>
</tr>
</tbody>
</table>

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by the applicable backfill installation specification. Refer to Section 312316.13 – Excavation, Trenching and Backfilling for Utilities.

2.3 MATERIAL TESTING:

A. Ensure that material selected, produced and delivered to the project meets applicable specifications and is of sufficient uniform properties to allow practical construction and quality control.
B. Source or Supplier Qualification. Perform testing, or obtain representative tests by suppliers, for selection of material sources and products. Provide test results for a minimum of three samples for each source and material type. Test samples of processed materials from current production representing material to be delivered. Tests shall verify that the materials meet specification requirements. Repeat qualification test procedures each time the source characteristic changes or there is a planned change in source location or supplier. Qualification tests shall include, as applicable:

1. Gradation: Complete sieve analyses shall be reported regardless of the specified control sieves. The range of sieves shall be from the largest particle through the No. 200 sieve.
2. Plasticity of material passing the No. 40 sieve.
3. Los Angeles abrasion wear of material retained on the No. 4 sieve.
5. Lightweight pieces.

C. Production Testing: Provide reports to the Engineer from an independent testing laboratory that backfill materials to be placed in the Work meet applicable specification requirements.

D. Assist the Engineer in obtaining material samples for verification testing at the source or at the production plant.

PART 3 - EXECUTION

3.1 SOURCES:

A. Use of material encountered in the trench excavations is acceptable, provided applicable specification requirements are satisfied. If excavation material is not acceptable, provide from another approved source.

B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that the Engineer may obtain samples for verification testing.

C. Obtain approval for each material source by the Engineer before delivery is started. If sources previously approved do not produce uniform and satisfactory products, furnish materials from other approved sources. Materials may be subjected to inspection or additional verification testing after delivery. Materials, which do not meet the requirements of the specifications, will be rejected. Do not use material, which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once the Engineer approves a material, expense for sampling and testing required to change to a different material will be credited to the Owner through a change order.

D. Bank run sand, select backfill, and random backfill, if available in the project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete the work from off-site sources.

E. The Owner does not represent or guarantee that any soil found in the excavation work will be suitable and acceptable as backfill material.
3.2 MATERIAL HANDLING:

A. When backfill material is obtained from either a commercial or non-commercial borrow pit, open the pit to expose the vertical faces of the various strata for identification and selection of approved material to be used. Excavate the selected material by vertical cuts extending through the exposed strata to achieve uniformity in the product.

B. Establish temporary stockpile locations for practical material handling and control, and verification testing by the Engineer in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near the project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering the drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL:

A. Quality Control:

1. The Engineer may sample, and test backfill at:
2. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
3. On-site stockpiles.
4. Materials placed in the Work
5. The Engineer may resample material at any stage of work or location if changes in characteristics are apparent.

B. Production Verification Testing: The Owner’s testing laboratory will provide verification testing on backfill materials, as directed by the Engineer. Samples may be taken at the source or at the production plant, as applicable.

END OF SECTION 312323.13
SECTION 312333 – TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 Summary

A. Section Includes

1. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

B. Related Sections

1. Backfill – Section 312323.13

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No additional payment will be made for trench excavation, embedment and backfill under this Section. Include cost in unit price for installed and underground piping, sewer, conduit, or duct work.

2. When Project Manager directs Contractor to over excavate trench bottom, Contractor will be paid by unit price bid per linear foot under bid item – 6-inches Over Excavation of Trench Bottom.

   a. No payment will be paid if Project Manager does not direct Contractor to over excavate trench bottom.

   b. No over excavation will be measured or paid when unsuitable conditions result from dewatering system not in compliance.

3. No additional payment will be made for performing Critical Location exploratory excavation. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.

4. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS:

A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: Material placed on either side of pipe from top of bedding up to spring line of pipe and horizontally from one trench sidewall to opposite sidewall.

D. Initial backfill: Portion of trench backfill that extends vertically from spring line of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching, and initial backfill.

F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.

G. Unsuitable Material: Unsuitable soil materials are the following:

1. Materials that can classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
3. Materials that contain large clods, aggregates, stones greater than 4 inches in an dimension, debris, vegetation, waste or any other deleterious materials.
4. Materials that are contaminated with hydrocarbons or other chemicals contaminants.

H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime, fly ash, or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.

I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom.

K. Surface Water Control: Diversion and drainage of surface water runoff and rainwater away from trench excavation. Rainwater and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regards to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench condition that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.

1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as a result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.

   a. No payment will be paid if Project Manager does not direct Contractor to over
      Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided
      in lieu of or to supplement ground water control systems to control seepage
and provide stable trench subgrade in predominately clayey soils prior to bedding placement.

b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided to embedment zine in combination with ground water control in predominately sandy or silty soils.

3. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high-water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

N. Sub-trench: Sub-trench is special case on benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.

O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit groundwater flow along trench.

P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings and backfilled with foundation bedding.

Q. Foundation Bedding: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required to control drainage and material separation. Foundation bedding is placed and compacted as backfill to provide stable support for bedding. Foundation bedding materials may include concrete seal slabs.

R. Trench Safety Systems include both protective systems and shoring systems.

S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forced imposed on it by cave in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.

U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.8, Special Shoring Design Requirements, for locations identified on drawings.

V. Vacuum Excavation: An excavation technique performed by an experienced subcontractor in which water or air jetting is used to sough off and vacuum away soil.

W. Large Diameter Water Line (LDWL): Water line that is 24-inches in diameter or larger.

X. Emergency Action Plan (EAP): The EAP document should include a discussion of procedures for timely and reliable detection, classification (level of emergency) and response procedure to potential emergency condition associated with a large diameter water line.
Y. Subsurface Utility Exploration (SUE): Non-destructive excavation, unless otherwise approved by project manager

1.4 REFERENCES


D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.


F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.

G. ASTM D 2922 - Standard Test Methods for Density and Unit Weight of Soil in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).


K. TxDOT Tex-110-E - Particle Size Analysis of Soils.


1.5 SCHEDULING:

A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

B. For proposed utility adjacent to or across existing LDWL:

1. Conduct a meeting between contractor, Drinking Water Operations and Utility Maintenance Branch prior to beginning excavation to coordinate the EAP in the event a water line shut down becomes necessary.

2. Notify Drinking Water Operations a minimum of 1 week prior to beginning construction activities.

3. Notify Drinking Water Operations a minimum of 48 hours prior to beginning SUE work near LDWL.
4. Unless otherwise approved by Owner, perform construction activities between 7AM and 5PM, Monday through Friday. No work permitted around LDWL on weekends or Holiday.

5. A TPWD Inspector must be present during SUE or construction activities occurring within four feet or one diameter of the LDWL, whichever is greater, from a LDWL or appurtenance.

1.6 SUBMITTALS:

A. Submit planned typical method of excavation, backfill placement and compaction including:

1. Trench widths
2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.

B. Submit backfill material sources and product quality information in accordance with requirements of Section 312323.13 – Backfill.

C. Submit trench excavation safety program, include designs for special shoring meeting requirements defined in Paragraph 1.8, Special Shoring Design Requirements contained herein.

D. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.

E. Submit 11-inch by 17-inch or 12-inch by 18-inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Project Manager.

F. For installation of proposed utility adjacent to or across existing LDWL, prepare and submit the following to Drinking Water Operations prior to beginning construction activities. Obtain approval from Drinking Water Operations prior to commencing pre-locate or utility work near LDWL.

1. Trench details, shoring system designs, installation sequences, and flowable fill mix designs.
2. Emergency Action Plan (EAP) to address contingency plans in the event of damage to or failure of LDWL. Include the following:
   a. Contact personnel and agencies including primary and secondary telephone numbers.
   b. Contractor’s hierarchy of responsible personnel,
   c. Traffic control measures, and
   d. Identification of resources to be available on or near project site in event of damage to or failure of LDWL.

1.7 TEST: (refer to section 312323.13)

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by City.
B. Perform backfill material source qualification testing in accordance with requirements of Section 312323.13 - Backfill.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS:
A. Have special shoring designed or selected by Contractor’s Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installation or improvements such as structure, pavements, and utilities. Special shoring may be a premanufactured system selected by Contractor’s Professional Engineer to meet project site requirements based on a manufacturer’s standard design.

PART 2 - PRODUCTS

2.1 EQUIPMENT:
A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
B. Use only hand-operated tamping equipment until minimum cover of 12-inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.
C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.
D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.8, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS:
A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section 312323.13 - Backfill
B. Concrete for Trench Dams: Concrete backfill, or 3 sack premixed (bag) concrete.

PART 3 - EXECUTION

3.1 EXCAVATION:
A. Provide adequate safety measures to prevent unauthorized persons or vehicles from entering or falling into any excavation, including but not limited to fences, gates, and barricades.
B. Excavate materials encountered to lines and grades indicated.
C. Excavate by open cut with trenching machine, backhoe or by hand operation. Do not use excavated material composed by large chunks or clods (greater than 6-inches in diameter) for backfill but dispose of such material offsite and provide other suitable material for backfill without additional expense.
D. During excavation, pile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides or cave-ins.

E. Remove from site excavated waste material not required or unsuitable for backfill.

F. Grade as necessary to prevent surface water from flowing into trenches or other excavations.

3.2 TRENCH EXCAVATION:

A. Cut banks of pipe trench as nearly vertical as practical. Remove stones as necessary to avoid point bearing. Over-excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe.

B. Dig the trench the proper width as specified. If the trench width below the top of pipe is wider than specified in this section or shown on the plans, then install a higher class of pipe and/or improved bedding as determined by the Engineer.

C. Accurately grade the trench bottom to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except where necessary to excavate for bell holes and for proper sealing of pipe joints. Dig bell holes and depressions for joint after the trench bottom has been graded. Make bell holes and depressions for joints no deeper, longer, or wider than needed to make the joint properly.

D. Do not over-excavate. If any excavation is carried beyond the lines and grades required or authorized, fill such space with cement stabilized sand or other suitable material as directed by the Engineer at no additional cost.

3.3 PIPE BEDDING:

A. Bedding for water and sewer lines shall be per the City of Galveston design standards and construction drawing details.

3.4 PROTECTION OR REMOVAL OF UTILITY LINES:

A. Anticipate all underground obstructions such as, but not limited to, water mains, gas lines, storm and sanitary sewers, telephone or electric light or power ducts, concrete, and debris. Any such lines or obstructions indicated on the drawings show only the approximate locations and shall be verified in the field by the Contractor. The Owner and Engineer will endeavor to familiarize the Contractor with all known utilities and obstructions, but this will not relieve the Contractor from full responsibility in anticipating all underground obstructions whether shown on the drawings.

B. Maintain in proper working order and without interruption of service all existing utilities and services which may be encountered in the work, except that with the consent of the Engineer such service connections may be temporarily interrupted to permit the Contractor to remove designated lines or to make temporary changes in the location thereof as will aid in the completion of the work and at the same time maintain services to property so originally benefited. The cost of making any temporary changes shall be at the Contractor’s expense and shall be incidental to the price of the project.

C. Before starting construction, the Contractor shall notify all utility companies involved to have their utilities located and marked in the field.
D. Contractor shall uncover all underground utilities to verify location and elevation in advance of construction near them so that adjustments can be made if necessary. The Contractor shall obtain all necessary permits.

3.5 BACKFILLING:

A. Criteria: Do not backfill trenches until all utility systems as installed conform to specified requirements of appropriate sections. Backfill trenches to ground surface with specified material. Reopen trenches improperly backfilled to depth required for proper compaction. Refill and recompact as specified or otherwise correct the condition in an approved manner.

B. Open Areas Not Under Pavement or Structures: Refer to Subsection 3.3 "Pipe Bedding" above for bedding requirements.

C. Pavement Sections:

1. Refer to Subsection 3.3 “Pipe Bedding” above for bedding requirements.
2. Above the pipe zone, deposit cement-stabilized sand backfill in 8-inch lifts to a point one foot below proposed pavement subgrade, and compact each layer to 95 percent Standard Proctor Density. Place suitable earth backfill up to the bottom of pavement. Cure cement stabilized sand top layer at least 3 days before placing earth backfill layer on top of it.

END OF SECTION 31 23 33
SECTION 31 31 16 – TERMITE CONTROL

PART 1 - GENERAL

1.1 SCOPE

A. The work of this Section includes:
   1. Termite pre-treatment for wood framing (no ground treatment).
   3. No periodic treatment is indicated.

1.2 SUBMITTALS

A. Product Data: For each type of termite control product. Include the EPA-Registered Label for termiticide products.

B. Qualification Date: For qualified Installer.

C. Warranties: Sample of special warranties

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer’s products.

PART 2 - PRODUCTS

2.1 TERMITE PRODUCTS

A. Pre-Treatment: BoraCare, or equal.

B. Post-Treatment: Termidor SC, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Apply products in strict accordance with manufacturer’s written instructions.

B. Pre-Treatment: Apply product to open framing, when access to all structural wood members is available.

C. Post-Treatment: Apply to building perimeter just prior to substantial completion.

END OF SECTION 03 31 16
SECTION 313200 – SOIL STABILIZATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and other Divisions 1 Specifications, apply to this section.

1.2 SUMMARY

A. Section includes providing soil stabilization of the exposed subgrade at the base of excavations below pavements as follows:

1. Lime Slurry Stabilization: Provide lime slurry stabilization of top 6” of subgrade at the base of excavations and each lift of select fill below vehicular pavements, uniformly distributed into the treated depth of the soil so that the dry lime solids content equals a minimum of 6% of the dry soil weight (approximately 28.4 lb. of lime solids per square yard of treated area), uniformly compacted with a smooth surface suitable for placing subsequent work.

2. Portland Cement Stabilization: Provide Portland cement stabilization of top 6” of subgrade at the base of excavations and each lift of select fill below vehicular pavements, uniformly distributed into the treated depth of the soil so that the dry Portland cement solids content equals minimum of 5% of the dry soil weight (23.6 lb. of Portland cement solids per square yard of treated area), uniformly compacted with a smooth surface suitable for placing subsequent work.

3. Geotextile Soil Stabilization: Provide woven geotextile soil stabilization over prepared subgrade areas to receive crushed limestone base course.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Commercial Lime Slurry: Provide a pumpable suspension of hydrated lime solids in water. Use lime made from "high calcium" type limestone. Use potable water for mixing, free of deleterious material and suitable for the purpose intended. Provide lime slurry complying with TX DOT Item 264, Type B, Commercial Lime Slurry requirements, such that the solids portion of the mixture, when considered on-the-basis of "solids content", shall consist principally of hydrated lime of composition, purity and fineness sufficient to meet the following requirements as to chemical composition and residue.

1. Chemical Composition and Purity: Hydrated lime Ca(OH)2 solids content not less than 87% by weight of lime slurry solids content.

2. Residue (Wet Sieve): Percent by weight residue retained in the "solids content" of lime slurry shall comply with the following:

a. Residue retained on a No. 6 (3,360-micron) sieve Max. 0.2%

b. Residue retained on a No. 30 (590-micron) sieve Max. 4.0%

3. GRADES
a. Grade 1: Dry solids content not less than 31% by weight of the slurry.
b. Grade 2: Dry solids content not less than 35% by weight of the slurry.
c. Grade 3: Dry solids content not less than 46% by weight of the slurry.

B. Fly Ash: TX DOT Departmental Materials Specification D-9-8900

C. Portland Cement: ASTM C 150, Type I or II

D. Subgrade Soil Stabilization Fabric: Woven, slit film, UV-stabilized, polypropylene fabric with an apparent opening sieve size (ASTM D 4751) of 40, 1% open area, permittivity (ASTM D 4491) of 0.05 sec⁻¹, permeability (ASTM D 4491) of 0.002 cm/sec, and flow rate (ASTM D 4491) of 4 gal/min/ft²; “Mirafi 600X”, or 4WS(UV)” distributed by Geo-Civ Products, Inc., Houston, TX, (Tel) 713-466-0104, or “Tenax TNT 100” by Tenax Corp., Jessup, MD, (Tel) 800-874-7437.

PART 3 - EXECUTION

A. LIME SLURRY APPLICATION:

1. Apply lime slurry with a distributor truck equipped with an agitator, which will keep the lime and water in a uniform mixture.

2. Distribute the lime slurry by successive passes over a measured section of subgrade and fill course until desired lime content has been achieved.

3. Thoroughly mix the lime/soil treated subgrade and fill course until a homogeneous, friable mixture free of clods is obtained.

4. Aerate or sprinkle mixture to obtain optimum moisture content (-2% to +2%).

5. Begin compaction at bottom of treated subgrade course and continue until entire depth of course is uniformly compacted to not less than 95% of maximum dry unit weight in accordance with ASTM D 698. Compact each fill course in a similar manner and continue until entire depth is uniformly compacted to not less than 95% of maximum dry unit weight in accordance with ASTM D 698.

6. Shape surface to within 0.05’ of lines and elevations indicated within two hours and finish by rolling with a pneumatic tire or other suitable roller.

7. Moisture cure completed subgrade for a minimum of 7 days before placing subsequent work.

8. When subgrade course treatment has set up sufficiently to prevent objectionable damage from traffic, such areas may be opened to construction traffic.

B. PORTLAND CEMENT APPLICATION:

1. Apply Portland cement with a distributor (nix by successive passes over a measured section of subgrade and fill course until required Portland cement content has been achieved.

2. Thoroughly mix each cement/soil treated subgrade course and fill courses until a homogeneous, friable mixture free of clods is obtained.

3. Aerate or sprinkle mixture to obtain optimum moisture content (-% to +2%).
4. Begin compaction at bottom of treated subgrade course and continue until entire depth is uniformly compacted to not less than 95% of maximum dry unit weight in accordance with ASTM D 698. Compact each fill course in a similar manner and continue until entire depth is uniformly compacted to not less than 95% of maximum dry unit weight in accordance with ASTM D 698.

5. Shape surface to within 0.05' of lines and elevations indicated within two hours and finish by rolling with a pneumatic tire or other suitable roller.

6. Moisture cure completed subgrade for a minimum of 7 days before placing subsequent work.

7. When subgrade course treatment has set up sufficiently to prevent objectionable damage from traffic, such areas may be opened to construction traffic.

C. FLY ASH/LIME SLURRY APPLICATION:

1. Scarify subgrade to 6" depth and provide soil stabilization of the exposed subgrade at the base of excavations to 5' outside building pad and vehicular pavements as follows and each lift of satisfactory excavated material used as fill as follows:
   a. Fly Ash: 42.1 lbs/sq. yard of treated area, 6" deep; and
   b. Lime Slurry: 15.8 lbs of lime solids/sq. yard of treated area, 6" deep

2. Apply fly ash with a distributor truck by successive passes over a measured section of subgrade and fill course until required Portland cement content has been achieved.

3. Apply lime slurry with a distributor truck equipped with an agitator that will keep the lime and water in a uniform mixture.

4. Distribute the lime slurry by successive passes over a measured section of subgrade and fill course until required lime content has been achieved.

5. Thoroughly mix the fly ash/lime soil treated subgrade and fill course until a homogeneous, friable mixture free of clods is obtained.

6. Aerate or sprinkle mixture to obtain optimum moisture content (-0% to +3%).

7. Begin compaction at bottom of treated subgrade course and continue until entire depth of course is uniformly compacted to not less than 95% of maximum dry unit weight in accordance with ASTM D 698. Compact each fill course in a similar manner and continue until entire depth is uniformly compacted to not less than 95% of maximum dry unit weight in accordance with ASTM D 698.

8. Shape surface to within 0.05' of lines and elevations indicated within two hours and finish by rolling with a pneumatic tire or other suitable roller.

9. Moisture cure completed subgrade for a minimum of 7 days before placing subsequent work.

10. When subgrade course treatment has set up sufficiently to prevent objectionable damage from traffic, such areas may be opened to construction traffic.
D. GEOTEXTILE STABALIZATION:

1. Proof-roll prepared subgrade surface to check for unstable areas and verify need for additional compaction. Do not begin installation of geotextile work until such unsatisfactory conditions have been corrected and are ready to receive subsequent construction.

2. Excavate anchor trenches approximately 12" wide and 12" deep at the outside edge of pavement aprons, unless otherwise indicated. Place geotextile stabilization fabric in trench along one side, stretching fabric to eliminate looseness and simultaneously placing and compacting backfill in trench to anchor fabric on one side of paving.

3. Stretch one piece of geotextile stabilization fabric across paving subgrade to remove wrinkles and slack areas, and anchor in opposite paving apron trench as previously specified.

4. Place subsequently installed geotextile stabilization fabric overlapping previous fabric 12" at laps.

END OF SECTION 313200
SECTION 314133 – TRENCH SAFETY SYSTEM

PART 1 - GENERAL

1.1 Summary:

A. Section Includes

1. Trench safety system for the construction of trench excavations.
2. Trench safety systems for structural excavations, which fall under provisions of state and federal trench safety laws.

1.2 MEASUREMENT AND PAYMENT:

A. Measurement for trench safety systems used on trench excavations shall be as indicated on the BID FORM.

B. No payment will be made for trench safety systems for structural excavations under this section. Include payment for trench safety system in applicable structure installation sections.

1.3 DEFINITIONS:

A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

B. The trench safety system requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.

C. Trench safety systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.4 SUBMITTALS:

A. Submit a safety program specifically for the construction of trench excavation. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations.

B. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid for by Contractor.

C. Review of the safety program by the Engineer will only be regarding compliance with this specification and will not constitute approval by the Engineer nor relieve Contractor of obligations under state and federal trench safety laws. No mobilization or commencement of work will be allowed unless the trench safety plan has been submitted and acknowledged.
1.5 REGULATORY REQUIREMENTS:

A. Install and maintain trench safety systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.

B. OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209 is available in the Federal Register.

C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).

PART 2 - PRODUCTS

2.1 Geotechnical Methods

A. The Contractor is responsible for obtaining borings and soil analysis as required for the system design.

2.2 Plan Description

A. The trench safety plan shall identify the project for which is was prepared in BOLD CAPITAL letters on the cover page.

B. The Trench Safety Plan shall be prepared by a licensed Civil Engineer in the State of Texas. The engineer who prepared the Plan shall affix his seal on the cover page of the Plan with a signature and date. Under no circumstances shall the date when the Plan is submitted to the Engineer for record purposes be greater than 14 days.

C. The Trench Safety Plan shall reference the types of soil conditions on-site for which it was prepared. Any and all OSHA guidelines shall be adhered to during the preparation of the Trench Safety Plan. Contractor shall be solely responsible for ensuring the Trench Safety Plan is adequate to complete the project.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.

B. Install specially designed trench safety systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.

C. A competent person, as identified in the Contractor's Trench Safety Program, shall verify that trench boxes and other pre-manufactured systems are certified for the actual installation conditions.
3.2 INSPECTION:

A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the trench safety systems to ensure that the installed systems and operations meet OSHA 29CFR and other personnel protection regulations requirements.

B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until Contractor has taken the necessary precautions to safeguard personnel entering the trench.

C. Maintain a permanent record of daily inspections.

D. Contractor shall post and have available on-site a copy of the trench safety plan for review by the Engineer, Owner, or public agency, as deemed necessary. Contractor shall hold weekly meetings with employees and any subcontractors regarding the trench safety plan to ensure compliance with the intent of the plan. Contractor shall notify Engineer prior to the meeting.

3.3 FIELD QUALITY CONTROL

A. Contractor shall verify specific applicability of the selected or specially designed trench safety systems to each field condition encountered on the project.

END OF SECTION 314133
PART 1 - GENERAL

1.01 SCOPE OF WORK

The work shall consist of the Helical Pile Contractor furnishing all labor, tools, equipment, materials and supervision to install Ram Jack® Helical Piles according to the specifications contained herein and shown on the construction drawings. The Helical Pile Contractor shall install a helical pile which will provide a minimum load capacity as indicated on the construction documents/plans.

1.02 DEFINITIONS

Some of the terms used in this specification may be unfamiliar to the reader, or may be used with a specific meaning not commonly known outside the helical pile industry. In determining the meaning of any term used herein, a definition contained in the following list shall take precedence.

A. Bearing Stratum – The undisturbed soil layer at any pile excavation location which provides a significant portion of the axial resistance of an installed helical pile bearing on one or more of the pile helices.

B. Contractor - The person/firm responsible for performing the helical pile work.

C. Crowd – Axial compressive force applied to the head (top) of the helical pile shaft during installation as required to ensure the pile progresses into the ground with each revolution a distance approximately equal to the helix pitch.

D. Extension – A pile section without helical plates. Extension(s) are installed after the lead section. Each extension is connected with integral couplings which provide a rigid load transferring connection. Their purpose is to extend the lead section with helical plates to a load bearing stratum.

E. Helix Driver – A high torque hydraulic motor used to advance (screw) a helical pile into the soil to a load bearing stratum. Depending on the capacity of the helix driver, it may be either hand held or machine operated.

F. Helical Pile – A steel pile consisting of one or more helical plates which is torqued into the soil until the lead section is embedded into a load bearing stratum. They’re purpose is to transfer structural loads (tension and/or compression) to a load bearing stratum.

G. Helix Plate – A round plate formed into a ramped spiral. When rotated into the soil, the helical shape provides thrust along its longitudinal axis thus aiding in pile installation. After installation, the plate transfers axial load into the soil through bearing.

H. Installation Torque – The resistance generated by a helical pile when installed into the soil. The installation resistance is a function of the strength properties of the soil the helical piles are being installed in as well as the shaft geometry of the pile shaft and helical plates.

I. Lead Section - The first helical pile section installed into the soil consisting of one or more helix plates welded to the pile shaft.
J. Torque Rating – The maximum torque energy that can be applied to a helical pile during installation into the soil.

1.03 REFERENCES

A. American Society of Testing and Materials (ASTM)
   a. ASTM-A29 Steel Bars, Carbon and Alloy, Hot Wrought and Cold Finished
   b. ASTM-A36 Structural Carbon Steel
   c. ASTM-A53 Welded and Seamless Steel Pipe
   d. ASTM-A500, Grade C, Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
   e. ASTM-A307 Carbon Steel bolts and Studs
   f. ASTM-563 Carbon and Alloy Steel Nuts

B. American Welding Society (AWS)
   a. AWS D1.1 Structural Welding Code – Steel

C. Society of Automotive Engineers (SAE)
   a. SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners

D. International Code Council - Evaluation Services (ICC-ES)
   a. Acceptance Criteria for Corrosion Protection of Steel Foundation Systems Using Polymer (EAA) Coatings (AC228)

1.04 SUBMITTALS

A. Five (5) sets of site specific shop drawings sealed by a registered professional engineer. Shop drawings to include:
   a. Helical pile/anchor identification number and location
   b. Helical pile/anchor design load
   c. Type and size of helical pile/anchor shaft
   d. Helical configuration (number and diameter of helical plates)
   e. Minimum effective torque required
   f. Connection details

B. Copies of certified calibration reports for all hydraulic gages. The calibrations shall have been performed within one (1) year of the proposed starting date of the pile installation.

C. Provide steel manufacturer's mill test reports, covering physical and chemical tests, for all steel piles.

D. Provide strength and properties sections of pile sections and calculations by a Professional Engineer demonstrating the pile will meet or exceed the strength requirements of the design loads as shown on the construction documents.
   a. If applicable, the calculation(s) shall include the load eccentricity on the pile. The eccentricity shall be measured from the vertical face of the footing to the center of the pile shaft.
   b. If the helical pile is deemed laterally unbraced per section 1808.2.5 of the International Building Code (IBC), the allowable load capacity calculation(s) of the pile shall take into
consideration the unbraced length of the pile per section 1808.2.9.2 of the International Building Code (IBC).

E. Installation Records: Within 7 days after pile installation, submit 2 copies of the installation record for each pile installed.
   a. The installation record shall clearly indicate the pile identification number or mark, pile diameter, helix configuration, installation depth, installation torque, ultimate and allowable capacity of pile.
   b. Where helical piles are being installed on existing structures provide final lifting force/design load applied to pile, the amount of elevation recovery of each pile.

1.05 QUALITY ASSURANCE

A. The Contractor performing the Work of this Section shall have been regularly engaged in pile work for a period of not less than 5 years and shall be properly equipped to execute the Work. If directed, furnish a list of projects of a similar type and magnitude executed by the Contractor.

B. In lieu of the Contractor achieving 5 years of Helical Pile experience, a certificate of competency can be provided by manufacturer. The certificate should state that the Contractor has been trained and is authorized to install the underpinning pile system or the manufacturer shall provide a letter expressing the ability and intent to provide on-site supervision of the pile installation.

C. Design of the helical piles/anchors shall be performed by a professional engineer licensed in the state of the project in accordance with existing building code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport, store, and handle piles in a manner to prevent damage to the piles. Piles shall be stored above the ground surface by pallets, blocking or other means.

PART 2 - PRODUCTS

2.01 MATERIAL

A. The helical piles/anchors shall have a central shaft that is cold formed welded and seamless carbon steel structural round tubing with a minimum yield strength of 65 ksi and meeting the dimensional and workmanship requirements of ASTM A500 as well as the following properties:

   2 3/8" diameter piling:
   Torsional strength rating = 4,000 ft-lbs
   Ultimate resistance capacity = 40,000 lbs

   2 7/8" diameter piling/anchor:
   Torsional strength rating = 8,000 ft-lbs
   Ultimate resistance capacity = 72,000 lbs

   3 ½" diameter piling/anchor:
   Torsional strength rating = 14,000 ft-lbs
   Ultimate resistance capacity = 98,000 lbs
4 ½” diameter piling/anchor:
Torsional strength rating = 23,000 ft-lbs
Ultimate resistance capacity = 138,000 lbs

B. Helix Plates:
   a. Shall conform to ASTM A-36 and have minimum yield strength ($F_y$) of 50 ksi.
   b. Shall have a minimum thickness of $\frac{3}{8}''$.

C. All other flat plate steel shall conform to ASTM A-36 unless noted otherwise on the plans.

D. All coupling connection thru bolts shall be ¾” diameter and conform to SAE J429 Grade 8 or equivalent. (minimum yield strength ($F_y$) = 130 ksi and minimum tensile strength ($F_u$) = 150 ksi)

E. All piling sections and brackets shall be coated with a polymer alloy thermoplastic powder coating, Plascoat PPA 571ES or equal, in compliance with ICC-ES acceptance criteria AC228 for corrosion resistance.

2.02 PERFORMANCE REQUIREMENTS

A. All helical piles shall be designed to support the design load(s) as shown on the plans.

B. Except where noted on the plans, all helical pile components shall be selected to provide a minimum factor of safety against ultimate mechanical failure of two (2).

C. The helical pile design shall take into account pile spacing, soil stratification and strain compatibility issues as are present for the project. See drawings for reference for the project geotechnical report. A copy of the project geotechnical report shall be provided to and reviewed by the Pile Contractor prior to bid submittal.

D. Where helical piles are subjected to lateral or base shear loads as indicated on the plans, the bending moment and stress from said loads shall be determined using a lateral load analysis program such as LPILE or equal commercially available software. The required soil parameters ($c$, $\phi$, $\gamma$ and $k_s$) for use with LPILE or equal shall be provided in the geotechnical report(s). The allowable lateral deflection of the helical pile shall be limited to one (1”) inch unless noted otherwise on the plans.

E. The helical pile bracket shall distribute the design load(s), as indicated on the plans, to the concrete foundation such that the concrete bearing stress does not exceed those in the ACI Building Code and the stress in the steel plate/welds do not exceed AISI allowable stresses for steel members.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before entering the construction site to begin work, the Helical Pile Contractor shall provide proof of insurance coverage as stated in the general specification and/or the contract.

B. The Helical Pile Contractor shall request markings of underground utilities by an underground utility location service. All efforts shall be made to protect any underground utilities encountered during the excavation and pile installation. Any separations or damage caused to the underground utilities shall be repaired/performed by a licensed professional.
C. Mark all pile installation locations as shown on the plans or approved shop drawings. The Engineer of Record shall be notified if the piles are relocated more than 12" from the locations shown on the plans or approved shop drawings. Relocation of the piles will not be allowed unless approved by the Engineer of Record.

D. A torque indicator shall be used during helical pile/anchor installation. The torque indicator can be an integral part of the installation system or externally mounted in-line.

E. A third party inspector shall be retained to oversee all aspects of installation of the helical piles/anchors. The items to be inspected include, but not limited to the following:
   a. Verify the type of helical pile/anchor being installed is as specified on the shop drawings.
   b. Verify final embedment depth of helical pile/anchor.
   c. Verify final installation torque readings as specified on the shop drawings.

3.02 INSTALLATION

A. The helical pile/anchor installation technique shall be such that it is consistent with the geotechnical, logistical, environmental and load carrying conditions of the project.

B. The lead section shall be positioned at the location as shown on the construction drawings. Battered helical piles/anchors can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required battered angle shall be established.

C. The helical pile/anchor sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 25 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the construction drawings. Connect sections together using coupling bolt(s) and nut torqued to snug tight per AISC.

D. Sufficient down pressure shall be applied to uniformly advance the helical pile/anchor sections approximately 3-inches per revolution. The rate of down pressure (crowd) shall be adjusted for different soil conditions and depths.

E. The minimum installation torque and minimum overall length criteria as shown on the construction drawings shall be satisfied prior to terminating the helical pile/anchor installation.

F. If the torsional strength rating of the pile shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
   a. Terminate the installation depth obtained subject to the review and acceptance of the Engineer of Record, or:
   b. Remove the existing helical pile/anchor and install a new one with fewer and/or smaller diameter helix plates. The new helix plate configuration shall be subject to review and acceptance of the Engineer of Record. If re-installing in the same location, the top-most helix of the new helical pile/anchor shall be terminated at least three feet (3'-0) beyond the terminating depth of the original helical pile/anchor.

G. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length and there is no maximum length constraint, the Contractor shall have the following options:
   a. Install the helical pile/anchor deeper using additional extension sections, or:
b. Remove the existing helical pile/anchor and install a new one with additional and/or larger diameter helix plates. The new helix plate configuration shall be subject to review and acceptance of the Engineer of Record. If re-installing in the same location, the top-most helix of the new helical pile/anchor shall be terminated at least three feet (3'-0) beyond the terminating depth of the original helical pile/anchor.

c. De-rate the load capacity of the helix pile/anchor and install additional helical piles/anchors. The de-rated capacity and additional helical piles/anchors location shall be subject to the review and acceptance of the Engineer of Record.

H. If the helical pile/anchor is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile/anchor removed. The obstruction shall be removed, if feasible, and the helical pile/anchor re-installed. If the obstruction can't be removed, the helical pile/anchor shall be installed at an adjacent location, subject to the review and acceptance of the Engineer of Record.

I. The Contractor shall conduct his construction operations in a manner to insure the safety of persons and property in the vicinity of the work. The Contractor's personnel shall comply with safety procedures in accordance with OSHA standards and any established project safety plan.

J. The portion of the construction site occupied by the Helical Pile Contractor, his equipment and his material stockpiles shall be kept reasonably clean and orderly.

3.03 FIELD QUALITY CONTROL

A. The Helical Pile Contractor shall furnish and install all helical piles per the plans and approved pile design documentation. In the event of conflict between the plans and approved pile design documentation, the contractor shall not begin construction on any affected items until such conflict has been resolved.

B. Centerline of helical piles/anchors shall not be more than 1/2 inch (1/2") from indicated plan location unless approved by the Engineer of Record.

C. Helical pile/anchor plumbness shall be within 2 degrees of the design alignment.

3.04 CLEAN UP

A. Within seven (7) days of completion of the work. The Helical Pile Contractor shall remove any and all material, equipment, tools, building materials, concrete forms, debris or other items belonging to the Contractor or used under the Contractor's direction.
SECTION 317300 – TUNNEL GROUTING

PART 1 - GENERAL

1.1 SUMMARY:
A. Mix design requirements, testing, furnishing and production of grout for:
   1. Pressure grouting of bolted liner plates for shafts.
   2. Pressure grouting of primary tunnel liner.
   3. Pressure grouting of jacked pipe.
   4. Annular grouting of cased or uncased sewer pipe.
   5. Grouting of the annular space between the sanitary sewer pipe and the primary tunnel liner.
   6. Grouting voids in ground resulting from caving, loss of ground, or settlement.
   7. Grouting of manholes constructed in shafts.
B. Compaction grouting is not part of this specification.

1.2 MEASUREMENT AND PAYMENT:
A. No separate payment will be made for work required under this Section. Contractor will include all costs of the requirements of this Section in the appropriate bid item(s) on the Bid Form.

1.3 DEFINITIONS:
A. Pressure Grouting: Filling a void behind a liner or pipe with grout under pressure sufficient to ensure void is properly filled but without overstressing temporary or permanent ground support or causing ground heave to occur.
B. Back Grouting: Secondary pressure grouting to ensure that voids have been filled between primary tunnel or shaft liners and the surrounding ground.
C. Annular Grouting: Filling the annular space between the carrier pipe and the primary tunnel liner, casing, or ground, by pumping.
D. Ground Stabilization Grouting: The filling of voids, fissures, or under-slab settlement due to caving or loss of ground by injecting grout under gravity or pressure to fill the void.

1.4 REFERENCE STANDARDS:
A. ASTM C 138 - Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
1.5 SUBMITTALS:

A. Submit a description of materials, grout mix, equipment and operational procedures to accomplish each grouting operation. The description may include sketches as appropriate, indicating type and location of mixing equipment, pumps, injection points, venting method, flowlines, pressure measurement, volume measurement, grouting sequence, schedule, and stage volumes.

B. Submit a grout mix design report, including:

1. Grout type and designation.
2. Grout mix constituents and proportions, including materials by weight and volume.
3. Grout densities and viscosities, including wet density at point of placement.
4. Initial set time of grout.
5. Bleeding, shrinkage/expansion.
6. Compressive strength.

C. For cellular grout, also submit the following:

1. Foam concentrate supplier’s certification of the dilution ratio for the foam concentrate.
2. A description of the proposed cellular grout production procedures.

D. Maintain and submit logs of grouting operations indicating pressure, density, and volume for each grout placement.
PART 2 - PRODUCTS

2.1 MATERIALS:

A. Grouting materials: Conform to concrete for utility construction, except as modified in the following paragraphs.

B. Grout Type Applications:

2. Grout for annular grouting: Low density (cellular) grout or sand-cement mortar mix.

C. Do not include toxic or poisonous substances in the grout mix or otherwise inject such substances underground.

2.2 GROUT:

A. Employ and pay for a commercial testing laboratory, acceptable to the Engineer, to prepare and test the grout mix design. Develop one or more mixes based on the following criteria as applicable:

1. Size of the annular void between sewer pipe and liner, or size of the void between primary liner and the surrounding soil.
2. Absence or presence of groundwater.
3. Adequate retardation.
4. Non-shrink characteristics.
5. Pumping distances.

B. Prepare mixes that satisfy the required application. Materials used in grout mix shall meet the following standards:

7. Sand for sand-cement mortar mix: ASTM C 144.

C. Provide grout that meets the following minimum requirements:

1. Minimum 28-day unconfined compressive strength: 1000 psi for sand-cement mortar grout; 300 psi for cellular grout.
2. Determine strength by ASTM C 942.

D. Fluidifier: Use a fluidifier, meeting ASTM C 937, which holds the solid constituents of the grout in colloidal suspension and is compatible with the cement and water used in the grouting operations.

E. Admixtures:
1. Use admixtures meeting ASTM C 494 and ASTM C 1017 as required, to improve pumpability, to control time of set, to hold sand in suspension and to reduce segregation and bleeding.

2. For cellular grout, do not use foam or admixtures that promote steel corrosion.

3. Ensure that admixtures used in a mix are compatible. Provide written confirmation from the admixture manufacturers of their compatibility.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Notify the Engineer at least 24 hours in advance of grouting operations.

B. Select and operate grouting equipment to avoid damage to new or existing underground utilities and structures.

C. In selection of grouting placement consider pipe flotation, length of pipe, length of tunnel, depth from surface, type of sewer pipe, type of pipe blocking and bulkheading, grout volume and length of pipe to be grouted between bulkheads.

3.2 EQUIPMENT:

A. Batch and mix grout in equipment of sufficient size and capacity to provide the necessary quality and quantity of grout for each placement stage.

B. Use equipment for grouting of a type and size generally used for the work, capable of mixing grout to a homogeneous consistency, and providing means of accurately measuring grout component quantities and accurately measuring pumping pressures. Use pressure grout equipment, which delivers grout to the injection point at a steady pressure.

3.3 PRESSURE GROUTING FOR PRIMARY TUNNEL AND SHAFT LINER:

A. Perform grouting operations to fill voids outside of the primary tunnel or shaft liner.

B. For non-expendable primary liners installed behind a shield or tunnel boring machine (TBM), fill voids with sand-cement grout promptly after each ring of the liner is out of the shield. Keep the grout pressure below a value that may cause damage or distortion to the installed liner plate rings. Provide seals on the tail of the shield or TBM, which will prevent grout from spilling.

C. For non-expendable primary liners installed by hand mining or in shafts, grout once every 4 feet or more frequently if conditions dictate.

D. Control grout pressures so that tunnel or shaft liner is not overstressed, and ground heave is avoided.

E. For liner requiring grout, perform back grouting once each shift, or more often if required to ensure that all voids are filled.
### 3.4 ANNULAR GROUTING FOR SEWER LINE IN TUNNELS AND IN CASED OR UNCASED AUGERS:

A. Fill the annular space between the sewer pipe and the tunnel primary liner, casing or ground, with grout.

B. Placement:

1. Placement Limits: The limits of each grout placement stage shall be predetermined by the size and capacity of the batching equipment and the initial set time of the proposed grout. Under no circumstances shall placement continue at a grout port longer than that period of time for the mix to take initial set. Grout hole spacing and locations shall be located according to the number of stages necessary to grout tunnel liners. A stage or lift cannot be installed on another lift until a proper set has been attained. Have placement procedures approved by the admixture or additive manufacturer.

2. Limit pressure on the annular space to prevent damage or distortion to the pipe or liner. Define the limiting and estimated required pressure range. Provide an open ended, high point tap or equivalent vent and monitor it at the bulkhead opposite to the point of grouting.

3. Pump grout until a material discharging is similar in consistency to that at point of injection.

4. In a primary lined tunnel, limit length of pipe installed to 200 feet or less before grouting the same length of sewer line. Repeat this cycle until all pipe is installed and grouted.

C. Remove temporary bulkheads installed for grouting.

D. Batch and mix cellular grout mechanically to ensure consistency of the mix. Wet solids thoroughly before introduction of the foaming agent. Operate the batching system to maintain slurry weight within 3 percent of design density. Introduce foam into slurry in accordance with the manufacturer's recommendations.

### 3.5 PRESSURE GROUTING FOR JACKED PIPE:

A. For jacked pipe 60 inches in diameter or greater pressure grout the annulus after installation, displacing the bentonite lubrication. Jacked pipes less than 60-inch diameter may be left ungrouted unless the excavated diameter exceeds the external pipe diameter by more than one inch.

B. Inject grout through grout holes in the sewer pipe. Drilling holes from the surface or through the carrier pipe walls is not allowed. Perform grouting by injecting it at the pipe invert with bentonite displacement occurring through a high point tap or vent.

C. Control ground water as necessary to permit completion of grouting without separation of the grout materials.

D. Limit pressures to prevent damage or distortion to the pipe or to keep flexible pipe within acceptable tolerances.

E. Pump grout until material discharging is similar in consistency to that at point of injection.
3.6 GROUND STABILIZATION GROUTING:

A. Completely fill voids outside the limits of excavation caused by caving or collapse of ground. Fill with gravity or pressure injected sand cement grout as necessary to fill the void.

B. Take care in grouting operations to prevent damage to adjacent utilities or public or private property. Grout at a pressure that will not distort or imperil any portion of the work or existing installations or structures.

C. Verify that the void has been filled by volumetric comparisons and visual inspection. In the case of settlement under existing slabs, take cores as directed by the Engineer, at no additional cost to the City, to demonstrate that the void has been filled.

3.7 FIELD QUALITY CONTROL:

A. Pressure Grouting for Primary Tunnel and Shaft Liners:
   1. For each shaft, make one set of four compressive test specimens for each 30-foot depth and one set for any remaining portion less than a 30-foot increment.
   2. Make one set of four compressive test specimens for every 200 feet of primary lined, (non-expandable) tunnel requiring grout.

B. Annular Grouting for Sewer Line in Tunnels and in Cased or Uncased Augers:
   1. Make one set of four compressive test specimens for every 200 feet of sewer pipe installed in primary lined tunnel.
   2. For cased or uncased augers, make one set of four compressive test specimens for each grouting operation, or for each 100 feet of pipe installed, whichever is more frequent.
   3. For cellular grout, check the slurry density both at point of batching and placement at least twice each hour in accordance with ASTM C 138. Record density, time, and temperature. Density must be within 3 percent of design density at point of batching and 5 percent of design density at point of placement.

C. Pressure Grouting for Jacked Pipe: Make one set of four compressive test specimens for every 400 feet of jacked pipe pressure grouting.

D. Ground Stabilization Grouting: Make one set of four compressive test specimens for every location where ground stabilization grouting is performed.

END OF SECTION 317300
DIVISION 32  EXTERIOR IMPROVEMENTS

SECTION 32 01 90 – TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1  SCOPE

A. The Work of this Section includes protection of trees and plants which are to remain as indicated on the Drawings.
B. RE: Landscape Drawings for additional information.

1.2  JOB CONDITIONS

A. Temporary Protections: Provide temporary fencing, barricades or guards to protect trees and other plants, which are to remain, from damage.
B. Protect Root Systems: Do not store construction materials, debris or excavated material within plant drip line (outer perimeter of tree branches). Do not permit vehicles or equipment within drip line. Restrict foot traffic with in drip line to prevent excessive compaction of soil over root systems.

PART 2 - PRODUCTS

2.1  MATERIALS

A. Safety Fencing:
   1. Chain link fencing.
   2. 4 feet high bright orange, light weight, reusable mesh safety fencing made of High Density Polyethylene with 1-1/2 inch x 3 inch size mesh.

PART 3 - EXECUTION

3.1  PROTECTION OF EXISTING TREES AND VEGETATION, GENERAL

A. Provide temporary fences, barricades and guards to protect trees and vegetation indicated or directed to remain or protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades and guards to protect trees and vegetation indicated or directed to remain.
B. Do not allow fires under or adjacent to trees or other plants which are to remain.

3.2  EXCAVATION AROUND TREES

A. Excavate within drip line of trees only where indicated.
B. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots; cut smaller roots which interfere with installation of new work. Cut roots with sharp pruning instruments; do not break, tear, or chop.
C. Where excavating for new construction is required within drip line of trees, hand excavate to minimize damage to root systems. Provide sheeting at excavations if required. Use narrow tine spading forks and comb soil to expose roots.

D. Relocate roots in backfill areas wherever possible. If large, main lateral roots are encountered, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 3 inches back from new construction. Coordinate with TPWD Construction Manager as needed.

E. Do not allow exposed roots to dry out before permanent backfill is placed; provide temporary earth cover, or pack with peat moss and wrap with burlap. Water and maintain in moist condition and temporarily support and protect from damage until permanently relocated and covered with earth.

3.3 GRADING AND FILLING AROUND TREES
A. Maintain existing grade within drip line of trees, unless otherwise indicated.

3.4 PROTECTION REMOVAL
A. Remove barricades and fences from around trees and vegetation upon Substantial Completion, or when directed by TPWD Construction Manager.

3.5 DISPOSAL OF WASTE MATERIALS
A. Burning or burying of removed trees, branch trimmings, and debris on Owner’s property is not permitted.

B. Remove and legally dispose of all excess excavation, displaced trees, trimmings, and debris from site.

END OF SECTION 32 01 90
SECTION 321216 – HOT-MIXED ASPHALT PAVING

PART 1 - GENERAL
A. Summary: Section includes furnishing and installing hot-mixed hot-laid asphalt surface course over prepared base course.

B. Related Work
1. Section 01 10 00 Summary
2. Section 31 23 00 – Earthwork: Subgrade preparation, grading, backfilling, and compaction.

C. Submittals: Submit surface course mix design.

PART 2 - PRODUCTS
A. Crushed Limestone Base Course: TxDOT Item 247, Type A, Grade 2 crushed limestone.
B. Prime Coat: Cutback asphalt, THD Item 300.2; MC-30, MC-70, or MC-250.
C. Tack Coat: Emulsified asphalt, THD Item 300.2, SS-1, CSS-1, or CSS-1h, diluted 1:1 emulsified asphalt/water.
D. Hot-Mixed Hot-Laid Asphalt Surface Course: THD item 340, Type D, with mineral filler not exceeding 3% by weight of combined aggregates.

PART 3 - EXECUTION
A. Inspection: Proof-roll prepared course surfaces to check for unstable areas and areas requiring additional compaction or which have become wet beyond acceptable limits. Do not begin paving work until deficient areas have been corrected and are ready to receive paving.

B. Preparation: Sweep completed base surface to remove loose granular material but do not dislodge aggregate from compacted base course. Apply prime coat at the rate of 0.20 to 0.50 gal/sq. yd. Over compacted subgrade and cure until at proper condition to receive paving.

C. Base Course:

D. Surface Course Installation: Machine place hot-mixed asphalt mixture on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of the mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt in a single lift.
   2. Spread mix at a minimum temperature of 250 deg F.
3. Begin applying mix along centerline of crown for crowned sections and high side of one-way slopes, unless otherwise indicated.

4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in paving mat.

5. Place paving in consecutive strips not less than 10 feet wide, unless infill edge strips of a lesser width are required. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.

6. Perform initial rolling, check surface and repair displaced areas by loosening and filling. Follow initial rolling by second rolling while material is still hot and continue until material is uniformly compacted. Perform finish rolling while mixture is still warm enough (minimum 185 deg F) to remove roller marks. Continue rolling until roller marks are eliminated and course has attained 97% +/- 3% of reference laboratory density.

7. Remove and replace paving areas with cracks, fissures and other defective areas with fresh, hot-mixed asphalt, roll and compact as specified. Do not permit vehicular traffic until paving has cooled and hardened.

8. Provide a surface course within a tolerance of +/-1/8 in 10'-0" when measured with a 10-foot straightedge when measured transversely or longitudinally to paved areas.

9. Erect barricades to protect paving from traffic until paving has cooled enough not to become marked, indented, or torn by traffic.

10. Allow completed surface course to cure a minimum of 30 days prior to application of striping.

E. Sealer Preparation: Perform surface repairs as indicated asphalt with patch material and tamp flush with adjacent surfaces in accordance with manufacturer’s printed instructions. Sweep asphalt surfaces to remove dust, dirt, and debris. Seal striping with Maintenance Inc. “Block Out Paint”, except of lines are excessively built-up, abrade to pavement surface.

F. Sealer Application: Prime old oxidized asphalt pavement with Maintenance, Inc. “Penetrating Primer J-220”. Uniformly dampen the clean pavement surface so that no free water appears on the palm of the hand after firmly pressed against the pavement, yet the pavement has a wet appearance. Apply sealer in two separate applications by squeegee or spray application at the rate of 0.10 to 0.15 gal/sq. yd for first coat and 0.08 to 0.12 gal/sq. yd. For second coat in accordance with manufacturer’s printed instructions. Apply second coat 90 deg to first coat. Restrict traffic and allow each coat to dry (to the touch) minimum 2 hours prior to recoating or striping. Allow sealer to cure a minimum of 24 hours prior to opening to traffic.

G. Disposal: Recycle removed material or legally dispose of excavated materials in an EPA-approved landfill.

END OF SECTION 321216
SECTION 321313 – CEMENT CONCRETE PAVING

PART 1 - GENERAL

A. Summary: Section includes providing cement concrete paving, walks, curbs and gutters, header, including expansion and control joints and concrete finishing.

B. Related Work:

1. General: Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.
   a. Section 31 23 00 Earthwork.
   b. Section 03 30 00 Cast-in-Place Concrete: General requirements for poured-in-place concrete.
   c. Section 31 20 00 Pavement Joint Sealants.

2. Quality Assurance: Provide an in place "mock-up" sample to demonstrate surface finish(s) and edge tooling for Architect's review. Maintain acceptable mockup sample during construction in an undisturbed condition as a standard for judging remainder of the pavement work.

PART 2 - PRODUCT

A. Concrete:

1. Provide 3,000 psi compressive strength concrete with minimum 500 psi flexural strength at 28 days. See Section 03 30 00 for concrete formwork, concrete materials, concrete reinforcing, shake-on color hardener (wheelchair ramps) and related materials, concreting placing, finishing, and curing procedures, except use membrane forming curing compound conforming to ASTM C 309, Type I or Type II, white pigmented. Color to be used at wheelchair ramps shall contrast with that of adjoining sidewalk shall be submitted to the Architect for approval.

B. Expansion Joints:

1. ASTM D 1751, asphalt saturated cellulosic fiber, in thickness shown, with 1/2" deep removable cap strip; "Conflex" by the Masonite Corp. or equivalent accepted by Architect. Space joints maximum 20' o.c., at driveway aprons, curbs, expansion joints and similar locations.

2. CRA "Construction Heart" Redwood at expansion joints, edges and similar locations indicated. Provide removable top strip.

C. Pre-molded Expansion Joint Filler Cap:

1. Greenstreak, Inc. St. Louis, (Tel) 636-225-9400, or 800-325-9504, "G-Seal" Style No. 605 extruded flexible PVC expansion joint cap complete with "G-Seal" adhesive for joining all splices to provide a watertight cap over redwood expansion joint filler.
D. Wheel Stops:

1. Precast, air entrained concrete; 2,500 psi minimum compressive strength; approximately 6" high x 9" wide x 84" long, with a vertical hole in each end for anchorage. Provide (2) #3 reinforcing bars running the length of the wheel stop. On concrete paving, use expansion bolts in place of drive pins and set wheel stop in a bed of epoxy grout.

PART 3 - EXECUTION

A. Proof-roll prepared sub-base surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving. Continue rolling and sprinkling to maintain subgrade compaction and moisture content required by Section 31 23 00 - Earthwork.

B. Refer to Section 03 30 00 for forming, reinforcing, placing, finishing and curing requirements for poured in place concrete. Provide expansion joints where indicated or maximum 30’ if not indicated. Place expansion joint dowels perpendicular to the plane of the joint. Provide 1/8” wide sawn weakened plane contraction joints in paving and tooled weakened plane contraction joints in walks, equal to 1/4 of depth of slab, at locations indicated. Tool edges and joints.

C. Provide fine hair broom finish at curbs and walks.

D. Provide broom finish at concrete paving.

E. Tool edges and joints of each pavement and walk panel, and each curb and gutter joint.

F. Comply with ADA and TAS requirements. Provide shake-on color hardener at wheelchair ramp surfaces.

END OF SECTION 321313
SECTION 321314 – PEDESTRIAN CONCRETE PAVING

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 Concrete Paving Including the Following:

1. Walks.
2. Trails
3. Special Pavements

B. Related Requirements:

1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions for projects administered by the TPWD
2. Section 321500 "Pavement Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
   a. Contractor’s superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.

B. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

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

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Construction Manager and not less than 96 inches by 96 inches.
3. Mock-ups shall be constructed where they do not interfere with the construction. Mock-ups shall remain on-site during construction.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Construction Manager specifically approves such deviations in writing.
5. Mock-ups shall not be considered part of the completed work and shall be removed once project is complete.
1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1.

C. Hot-Weather Concrete Placement: Comply with ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I or Type II.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate (Top Cast Finishes): Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
   1. Aggregate Sizes: 3/8 to 5/8 inch nominal.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
   1. Color: As indicated on the drawings.

G. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING MATERIALS

A. Water: Potable.

B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Dayton Superior.

C. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Butterfield Color, Inc.

2. Color: As selected by TPWD Construction Manager and Landscape Architect from manufacturer's full range.

D. Pavement Joint Sealants: Color to match adjacent paving as selected by TPWD Construction Manager and Landscape Architect.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use plasticizing and retarding 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.

C. 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.

D. Concrete Mixtures: Normal-weight concrete.

2. Maximum W/C Ratio at Point of Placement: 0.50.
3. Slump Limit: 5 inches, plus or minus 1 inch.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
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 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch <insert dimension> according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
   a. Tolerance: Ensure that grooved joints are within 2 inches either way from centers of dowels.

   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 developing random contraction cracks.
   a. Tolerance: Ensure that sawed joints are within 2 inches either way from centers of dowels.

D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
D. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. MediumTextured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
   1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
   2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
   3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer’s written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer to match paving color required.
2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
3. After final power floating, apply a hand-troweled finish followed by a broom finish.
4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to 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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Construction Manager, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Construction Manager but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Construction Manager.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.
3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by TPWD Construction Manager and Landscape Architect or Construction Manager.

B. Drill test cores, where directed by Construction Manager, when necessary to determine magnitude of cracks or defective areas. Replace concrete panels with cores to match adjacent.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313
SECTION 321500 – PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies joint sealants for concrete-to-concrete and concrete-to-asphalt pavement joints.

B. Preconstruction Joint-Sealant-Substrate Tests: Submit substrate materials, representative of actual joint surfaces, to joint sealant manufacturer for laboratory testing of joint sealants for adhesion to primed and unprimed substrates and for compatibility with joint substrates and other joint-related materials.

C. Submittals: In addition to product data, submit the following:

1. Samples of each type and color of joint sealant required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.

B. Colors: Provide color indicated for exposed joint sealants or, if not indicated, as selected by Architect from manufacturer's full range for this characteristic.

C. Cold-Applied Joint Sealants: Provide manufacturer's standard products complying with the following requirements:

1. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, non-sag silicone sealant complying with ASTM D 5893 for Type NS.

2. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

2. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petro-polymer and activator components producing a pourable, self-leveling sealant.

D. Hot-Applied Joint Sealants: Provide manufacturer's standard products complying with the following requirements:


E. Joint-Sealant Backer Materials: Non-staining; compatible with joint substrates, sealants, primers and other joint fillers; and approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

1. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

3. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

F. Primers: As recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with joint sealant manufacturer’s written instructions applicable to products and applications indicated.


C. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

END OF SECTION 321500
SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Fence framework, fabric, and accessories.
2. Excavation for post bases, concrete foundation for posts and center drop for gates.

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required in this Section. Contractor will include all costs of the requirements of this section in appropriate bid item(s) on Bid Form.

1.3 REFERENCES:

B. ANSI/ASTM F 567 - Installation of Chain-Link Fence.
C. ASTM A 116 – Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
D. ASTM A 120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
E. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
F. ASTM A 392 – Zinc-Coated Steel Chain-Link Fence Fabric.
G. ASTM A 428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.
H. ASTM C 94 – Ready-mixed Concrete.
I. ASTM F 573 - Residential Zinc-Coated Steel Chain Link Fence Fabric.
J. ASTM F 668 - Poly (Vinyl Chloride) (PVC) Coated Steel Chain Link Fence Fabric.
K. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.
L. FS RR-F-191 - Fencing, Wire and Post Metal (and Gates, Chain Link Fence Fabric, and Accessories).

1.4 SYSTEM DESCRIPTION:

A. Fence height shall be eight feet or as noted to match height of existing.
B. Line post spacing shall not exceed 10 feet, or as shown on Drawings.

C. Where there are existing chain link fences, all components shall match existing.

1.5 SUBMITTALS:

A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

B. Product Data: Provide data on fabric, posts, accessories, fittings, and hardware that indicates that items match or exceed the quality of existing items.

1.6 QUALIFICATIONS:

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years' experience.

1.7 FIELD MEASUREMENTS:

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.

B. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: As indicated on Drawings.

2. Steel Wire for Fabric: Wire diameter of 0.192 inch.
   a. Mesh Size: 2 inches.
   b. Polymer-Coated Fabric: ASTM F 668, Class 2b over zinc-coated steel wire.
      1) Color: Black, according to ASTM F 934.
   c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.

3. Selvage: Knuckled at both selvages.
2.3  FENCE FRAMEWORK

A.  Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1.  Fence Height: As indicated on Drawings.
2.  Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
   a.  Line Post: 2.875 inches in diameter.
3.  Horizontal Framework Members: Top and bottom rails according to ASTM F 1043.
   a.  Top Rail: 1.66 inches in diameter.
5.  Metallic Coating for Steel Framework:
   a.  Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating according to ASTM A 653/A 653M.
6.  Polymer coating over metallic coating.
   a.  Color: Black, according to ASTM F 934.

2.4  TENSION WIRE (where accepted in lieu of bottom rail)

A.  Polymer-Coated Steel Wire: 0.177-inch-diameter, tension wire according to ASTM F 1664, Class 2b over zinc-coated steel wire.
1.  Color: Black, according to ASTM F 934.

2.5  SWING GATES

A.  General: ASTM F 900 for gate posts and swing gate types.
1.  Gate Leaf Width: As indicated.
2.  Erect gates so they swing or slide in the appropriate direction. Provide gate stops as required. Adjust hinges and diagonal bracing so that gates will hang level. Adjust rollers and guides of sliding gates so that gates are level.
3.  Framework Member Sizes and Strength: Based on gate fabric height as indicated.

B.  Pipe and Tubing:
1.  Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framework
2.  Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Assembled with corner fittings.

D. Hardware:
   1. Hinges: 360-degree inward and outward swing.
   2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
   3. Lock: Padlock as directed by TPWD

2.6 FITTINGS (All Fittings shall receive the same polymer coating as fence fabric)

A. Provide fittings according to ASTM F 626.

B. Post Caps: Provide for each post.
   1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:
   1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
   2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dipped galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
   1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
      a. Hot-Dip Galvanized Steel; galvanized coating thickness matching coating thickness of chain-link fence fabric.

I. Finish:
   1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft of zinc.
      a. Polymer coating over metallic coating.
PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install chain link fence in accordance with the directions of the manufacturer and these Specifications.

B. Install fence posts at not more than 10-foot centers and at least 36 inches into the ground in a Class B concrete base. Allow concrete to cure for at least 7 days before erecting remainder of fence. Fasten fabric to line posts with wire ties spaced about 14 inches apart and to top rail spaced about 24 inches apart.

C. Use standard chain link fence-stretching equipment to stretch the fabric before tying it to the rails and posts. Repeat the stretching and tying operations about every 100 feet.

D. Erect gates so they swing or slide in the appropriate direction. Provide gate stops as required. Secure hardware, adjust, and leave in perfect working order. Adjust hinges and diagonal bracing so that gates will hang level. Adjust rollers and guides of sliding gates so that gates are level.

E. At small natural or drainage ditches where it is not practical for the fence to conform to the contour of the ground, span the opening below the fence with wire fastened to stakes of required length. The finished fence shall be plumb, taut, true to line and ground contour. When directed, stake down the chain link fence at several points between posts.

F. Where new fence joins an existing fence, set a corner post and brace post at the junction and brace as directed. If the connection is made at other than the corner of the new fence the last span of the old fence shall contain a brace.

END OF SECTION 323113
SECTION 323114 - GATE OPERATORS

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. Gate Operators for Swing & Slide Gates

B. Related Requirements:
   1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions for projects administered by the TPWD
   2. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete equipment bases/pads for gate operators and controls.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
   2. Review sequence of operation for each type of gate operator.
   3. Review coordination of interlocked equipment specified in this Section and elsewhere.
   4. Review required testing, inspecting, and certifying procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Gate operators, including operating instructions and motor characteristics.

B. Shop Drawings: For each type of fence and gate assembly.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include accessories, hardware, gate operation, and operational clearances.
   3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
   4. Wiring Diagrams: For power, signal, and control wiring.
1.5 INFORMATIONAL SUBMITTALS
   A. Product Certificates: For each type of gate operator.
   B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE
   A. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.8 FIELD CONDITIONS
   A. Field Measurements: Verify layout information for gate operators based on field condition of gates and drive aisles. Verify dimensions by field measurements.

1.9 WARRANTY
   A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Faulty operation of gate operators and controls.
      2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GATE OPERATORS
   A. Operators: Factory-assembled, automatic, gate-operating system designed for gate size, type, weight, and frequency of use. Control system shall have characteristics suitable for Project conditions, with control stations, safety devices, and weatherproof enclosures.
      1. Operator design shall allow for removal of cover or motor without disturbing limit-switch adjustment and without affecting auxiliary emergency operation.
      2. Electronic components shall have built-in troubleshooting diagnostic feature.
      3. Unit shall be designed and wired for both right-hand/left-hand opening, permitting universal installation.

   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. UL Standard: Manufacture and label gate operators according to UL 325.
D. Motors: Comply with NEMA MG 1.
   1. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
   2. Service Factor: 1.15.
   3. Electrical Characteristics:
      a. Horsepower: As Indicated
      b. Voltage: As Indicated

E. Gate Operators: Gate and Equipment base/pad mounted and as follows:

1. Hydraulic Swing Gate Operators:
   b. Gate Speed: Minimum 60 feet per minute.
   c. Maximum Gate Weight: 500 lb.
   d. Frequency of Use: 60 cycles per hour.
   e. Operating Type: Crank arm.
   f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
   g. Locking: Hydraulic in both directions.

2. Mechanical Slide Gate Operators:
   b. Gate Speed: Minimum 60 feet per minute.
   c. Maximum Gate Weight: 1,000 lb.
   d. Frequency of Use: 10 cycles per hour.
   e. Drive Type: Enclosed worm gear reducers, rigid track drive.

F. Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA 250, Type 4 enclosure for pedestal mounting and with space for additional optional equipment.

G. Control Devices:

1. Digital Keypad Entry Unit: Multiple-programmable-code capability of not less than 500 possible individual codes, consisting of four-digit codes, and permitting four different access time periods.
   a. Features: Limited-time usage and Capable of monitoring and auditing gate activity.
   b. Face-lighted unit with keyless-membrane keypad fully visible at night.

2. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide two programmable transmitter(s) with multiple-code capability, permitting validating or voiding of not less than 1000 codes per channel configured for the following functions:
   a. Transmitters: Three-button operated, with open and close function.
   b. Channel Settings: Four independent channel settings controlling separate receivers for operating more than one gate from each transmitter.
3. Vehicle Loop Detector: System that includes automatic closing timer with adjustable time delay before closing and loop detector designed to open and close gate. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, and as recommended in writing by detection system manufacturer for function indicated.
   a. Loop: Factory-preformed wire, for saw-cut and epoxy-grouted installation.

H. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
   1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.
   2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
   3. Photoelectric/Infrared Sensor: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.

I. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully open and fully closed positions.

J. Emergency Release Mechanism: Quick-disconnect release of operator drive system, permitting manual operation if operator fails. Control circuit power is disconnected during manual operation.
   1. Type: Mechanical device, key, or crank-activated release.

K. Operating Features:
   1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability for monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
   2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
   3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
   5. Open Override Circuit: Designed to override closing commands.
   6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
   7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
   8. Clock Timer: Seven day, programmable for regular events.

L. Accessories:
   2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
a. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.

3. External electric-powered magnetic lock with delay timer allowing time for lock to release before gate operates.

4. Fire box.

5. Instructional, Safety, and Warning Labels and Signs: According to UL 325

6. Equipment Bases/Pads: Cast-in-place or precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate-operator component manufacturer's written instructions.

2.2 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by TPWD Construction Manager.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GATE-OPERATOR INSTALLATION

A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.

C. Vehicle Loop Detector System: Cut grooves in pavement, bury, and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

D. Ground electric-powered motors, controls, and other devices according to NFPA 70 and manufacturer's written instructions.
3.3 ADJUSTING

A. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
   1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
   2. Test and adjust operators, controls, alarms, and safety devices. Replace damaged and malfunctioning controls and equipment.
   3. Lubricate operator and related components.

B. Lubricate hardware and other moving parts.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323114
SECTION 329200 - TURF AND GRASSES

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. Seeding.
   2. Hydroseding.
   4. Meadow grasses and wildflowers.

B. Related Requirements:
   1. Uniform General Conditions for State of Texas Contracts including Supplementary General Conditions for projects administered by the TPWD
   2. Section 31 23 00 "Earthwork" for grading of lawns and native planting areas.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  1. Certification of each turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.

  1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
  3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

     a. Landscape Industry Certified Technician - Exterior.
     b. Landscape Industry Certified Lawncare Manager.
     c. Landscape Industry Certified Lawncare Technician.

  5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation"
sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: As indicated on the drawings.

C. Grass-Seed Mix: Proprietary seed mixes as indicated on the drawings.

2.2 TURFGRASS

A. Turfgrass Species: As indicated on the drawings.

2.3 MEADOW GRASSES AND WILDFLOWERS

A. Wildflower and Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as indicated on the drawings.

B. Seed Carrier: Inert material, sharp clean sand or perlite.

2.4 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 MULCHES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.6 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Herbicide for Native Vegetation Restoration and turf grasses:
   1. Plateau Herbicide (Ammonium salt of Imazapic23.6%) or approved equal.
   2. Methylated Seed Oil as a surfactant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by TPWD Construction Manager and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

B. Before planting, obtain TPWD Construction Manager and Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 HYDROSEEDING

A. Hydroseeding: Mix specified seed, commercial fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with nonasphaltic tackifier.
   2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
   1. Lay sod across slopes exceeding 1:3.
   2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.
3.6 Satisfactory Turf

A. Turf installations shall meet the following criteria as determined by TPWD Construction Manager and Landscape Architect:

1. Satisfactory Seeded Turf: At substantial completion, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

2. Satisfactory Sodded Turf: At substantial completion, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.7 Pesticide Application

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

C. Herbicide for Native Vegetation Restoration and turf grasses shall be applied post emergence of plants when the emerged grasses are 8" tall for all disturbed areas. Application shall be as directed on the herbicide label under the section “Revegetation with Prairie Grasses and other Forage Grasses” and using Methylated Seed Oil as a surfactant.

3.8 Cleanup and Protection

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200
SECTION 330110.58 - DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:
   A. Section Includes
      1. Disinfection of potable water lines and water plant piping for raw and finished water.

1.2 MEASUREMENT AND PAYMENT:
   A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.
   B. Subsequent disinfection operations which may be necessary due to nonconforming or incomplete construction will be at the Contractor’s expense.

1.3 REFERENCES:
   A. AWWA C 651 - Disinfecting Water Mains.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 CONDUCTING DISINFECTION:
   A. Water lines constructed shall be promptly disinfected before any tests are conducted on water lines and before water lines are connected to the Owner’s water distribution system.
   B. Water for disinfection and flushing will be furnished by the Owner without charge for initial disinfection. If the disinfection fails testing, Contractor shall be charged for water at the owner’s lowest rate.
   C. Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations.
   D. Coordinate chlorination operations through the Engineer.

3.2 PREPARATION:
   A. Use required temporary blind flanges, cast-iron sleeves, plugs, and other items needed to facilitate disinfection of new mains prior to connection to the water distribution system. Normally, each valved section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.
B. Slowly fill each section of pipe with water in a manner approved by the Engineer. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

C. Excavations shall be backfilled immediately after installation of risers or blow-offs.

D. Install blow-off valves at end of main to facilitate flushing of dead-end water mains. Install permanent blow-off valves according to Drawings.

3.3 DISINFECTION BY OWNER’S PERSONNEL:

A. Correct problems that may prevent disinfection operations prior to advising the Engineer to perform disinfection work. When disinfection work cannot be performed due to covered up valves, missing valve stacks, inoperative fire hydrants or other nonconforming construction, a charge will be levied against Contractor for each trip made by the Owner’s personnel.

B. Notify and coordinate with the Engineer a minimum of 48 hours before disinfection work is to be performed. Assist the Owner’s personnel during disinfection operations.

3.4 DISINFECTION BY CONTRACTOR:

A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:

1. Use not less than 100 parts of chlorine per million parts of water.
2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 part per million parts of water.
4. Open and close valves in lines being sterilized several times during contact period.
5. If a chemical compound is used for a sterilizing agent, it shall be placed in pipes as directed by the Engineer.

3.5 BACTERIOLOGICAL TESTING:

A. After disinfection and flushing of water lines, bacteriological tests will be performed by Owner or testing laboratory. If test results indicate need for additional Disinfection of Water Utility Piping Systems based upon Texas Commission on Environmental Quality (TCEQ) requirements, Contractor shall repeat the disinfection at no cost to the Owner.

3.6 COMPLETION:

A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION 330110.58
SECTION 330504 - SELECTIVE DEMOLITION FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

A. SCOPE

1. This section includes removing existing utility structures, facilities, and materials as shown on the plans.
2. Turnover of salvageable materials and equipment to Owner.

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this Section. Contractor will include all costs of the requirements of this Section in the appropriate bid item(s) on the Bid Form.

1.3 SUBMITTALS:

A. Submit proposed methods, equipment, materials and sequence of operations for demolition of equipment and materials. Plan operations to minimize temporary disruption of utilities to existing facilities or adjacent property.

B. Submit proposed demolition and removal schedule for approval. Notify Engineer in writing at least 48 hours before starting demolition.

1.4 OWNERSHIP OF MATERIAL AND EQUIPMENT:

A. Materials and equipment designated for reuse or salvage are listed on the plans. Protect items designated for reuse or salvage from damage during demolition, handling and storage. Restore damaged items to satisfactory condition.

B. Materials and equipment not designated for reuse or salvage become the property of and the responsibility of the Contractor.

1.5 STORAGE AND HANDLING

A. Store and protect materials and equipment designated for reuse until time of installation.

B. Deliver items to be salvaged to Owner as directed by the Engineer.

C. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Remove material as work progresses to avoid clutter. Properly dispose of all waste material in accordance with applicable laws and regulations.

1.6 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. Use temporary enclosures and other suitable methods to prevent the spread of dust, dirt and debris, or other methods.

B. Use appropriate controls to limit noise from demolition to levels designated in local ordinances.
C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Stop demolition and notify Engineer if underground fuel storage tanks, asbestos, PCBs, lead based paint, contaminated soils, or other hazardous materials are encountered.

E. Dispose of removed equipment, materials, waste and debris in a manner conforming to applicable laws and regulations.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS FOR DEMOLITION OF UTILITIES:

A. Use equipment and materials approved under Paragraph 1.B., Submittals.

B. Fires are not permitted.

C. Do not use a “drop hammer” where the potential exists for damage to underground utilities, structures, or adjacent improvements.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Prior to utility demolition, inspect with Engineer to determine the condition of existing structures and features adjacent to items designated for demolition.

B. Engineer will mark or list existing equipment to remain the property of the Owner.

C. Do not proceed with demolition or removal operations until after the joint inspection and subsequent authorization by the Engineer.

3.2 PROTECTION OF PERSONS AND PROPERTY:

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to the property or adjacent property and facilities.

D. The Contractor shall be responsible for safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered. Resume demolition only after proper protective measures have been taken.

E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.3 UTILITY SERVICES:

A. Follow rules and regulations of authorities or companies having jurisdiction over communications, pipelines, and electrical distribution services.
B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

3.4 DISPOSAL:

A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage.

B. Follow method of disposal as required by regulatory agencies.

3.5 BACKFILL:

A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to a density of 90 percent standard Proctor.

B. Do not backfill with material from demolition unless approved by Engineer.

3.6 MECHANICAL WORK ITEMS:

A. Mechanical removals consist of dismantling and removing existing piping, pumps, motors, equipment and other appurtenances. It includes cutting, capping, and plugging required to restore use of existing utilities.

END OF SECTION 330504
SECTION 330505.31 – HYDROSTATIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Field hydrostatic testing of newly installed water piping and pipelines.
2. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) and large-diameter (greater than 20 inches) water lines. When specifications for large-diameter water lines differ from those for small-diameter water lines, paragraphs for large-diameter lines will govern for large-diameter pipe. Water piping includes plant piping.

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.1 MANUFACTURER HYDROSTATIC TESTING

A. Pipe and fittings shall be tested and marked in accordance with AWWA Standards C900-16, C909-09, C151-17, C200-17, C300-17, C301-14, C302-16, C303-17, or latest revisions, for whichever is applicable to the type of pipe material being supplied.

3.2 FIELD HYDROSTATIC TESTING AFTER INSTALLATION

A. PREPARATION:

1. New mains shall be thoroughly disinfected in accordance with AWWA Standard C-651 and then flushed and sampled before being placed in service. Samples shall be collected for microbiological analysis to check the effectiveness of the disinfection procedure. Sampling shall be repeated if contamination persists. A minimum of one sample for each 1,000 feet of completed waterline will be required or at the next available sampling point beyond 1,000 feet as designated by the design engineer.
2. Hydrostatically test newly installed water piping and pipelines after disinfection, if required, and before connecting to the Owner’s water distribution system.
3. Water for testing will be provided to Contractor at no charge by the Owner for the initial test and one (1) retest, if required.
4. For large-diameter water lines, test pipelines in lengths between valves, or plugs, of not more than 4400 feet.
5. Small-diameter pipe shall be tested in lengths between valves, or plugs, of not more than 1500 feet.
6. Conduct hydrostatic tests in presence of the Engineer.

B. TEST PROCEDURES:
1. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.
2. Allow piping and pipeline to sit a minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.
3. For small-diameter pipe, expel air and apply a minimum test pressure of 125 psi. For large-diameter pipe, expel air and apply a minimum test pressure of 150 psi.
4. Begin test by 9:00 a.m. unless otherwise approved by the Engineer. Maintain test pressure for 8 hours. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.
5. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

C. ALLOWABLE LEAKAGE FOR WATERLINES:
1. During hydrostatic tests, no leakage will be allowed for sections of water lines and piping consisting of welded joints.
2. Maximum allowable leakage for water piping and lines with rubber gasketed joints: 10.63 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at 125 psi or 11.65 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at 150 psi.

D. CORRECTION FOR FAILED TESTS:
1. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
2. The Engineer may require failed pipe to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Section 33 01 10.58 - Disinfection of Water Utility Piping Systems. Contractor shall pay for water required for additional disinfection and retesting.
3. Repeat test until satisfactory results are obtained.

E. COMPLETION:
1. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION 330505.31
SECTION 330507.36 – MICROTUNNELING AND PIPE JACKED TUNNELS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes

1. Tunnel construction of water pipe. Methods include tunnel boring machine (TBM) or micro-tunnel boring machine (MTBM).
2. Tunnel construction of sewers by one-pass methods with or without man entry. The construction methods involve jacking pipe following a hand-shield excavation or a tunnel boring machine (TBM) or micro-tunnel boring machine (MTBM), with the pipe serving as both the tunnel liner during construction and the sewer pipe after completion of construction.
3. Contractor may select centrifugally cast fiberglass pipe (FRP), vitrified clay pipe (VCP), or reinforced concrete pipe (RCP) for storm or sanitary sewers. Use plastic-lined RCP for sanitary sewers. Unlined RCP or RCP lined with a liner other than that specified will not be allowed for sanitary sewers.

1.2 MEASUREMENT AND PAYMENT:

A. Unit Prices:

1. The length of the water installed will be measured by linear foot along the center line of the completed water from bore pit to bore pit, as designated on the Drawings.
2. The length of the sewer installed will be measured by linear foot along the center line of the completed sewer from bore pit to bore pit, as designated on the Drawings; and to the end of stubs or the termination of the pipe. The installation of the sewer within the limits of a structure other than manholes will not be considered for measurement and payment at the unit price bid.
3. Payment will include and be full compensation for labor, equipment, materials, and supervision for construction of the water or sewer and excavation, complete in place including disposal of excess materials, sheeting, shoring or bracing, dewatering, utility adjustments, connections to existing sewers, grouting (if required), tests, backfilling, clean-up, and other related work necessary for construction as specified or as shown on the Drawings.
4. Payment for the installation of the water or sewer will be authorized by the Owner’s Engineer in two parts. Pay estimates for partial payments will be made as measured above according to the following schedule:
   a. 95 percent payment will be made for jacked pipe installed but not yet grouted, in cases where grouting is specified.
   b. 100 percent payment will be authorized on a linear foot basis for the amount of jacked sewer pipe installed, including grouting when specified.
5. Monitoring will be paid for at the lump sum price for installations, observations, and reporting.

B. Stipulated Price (Lump Sum): If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the Total Stipulated Price.
1.3 REFERENCES:
A. American Railway Engineering Association (AREA) Manual for Railway Engineering.
B. American Association of State Highway and Transportation Officials (AASHTO).
C. Occupational Safety and Health Administration (OSHA).
D. National Electrical Code - (NFPA 70).

1.4 DEFINITION:
A. Jacked Pipe: A method for installing sewer pipe that serves as initial construction lining and tunnel support, installed for stability and safety during construction, and as the sewer pipe. The pipe is shoved forward, or jacked, as the tunnel is advanced.
B. Microtunneling: A method of installing pipe by jacking the pipe behind a microtunnel boring machine which is connected to and shoved forward by the pipe being installed, generally precluding man entry.
C. Tunnel Boring Machine (TBM): Mechanized excavating equipment that is a steerable, guided and articulated, connected to and shoved forward by the pipe being installed, with man entry.
D. Microtunnel Boring Machine (MTBM): Mechanized excavating equipment that is remotely controlled, steerable, guided and articulated, connected to and shoved forward by the pipe being installed, usually precluding man entry.
E. Tunneling Methodology: A written description, together with supporting documentation that defines Contractor's plans and procedures for the microtunneling or pipe jacking operations.
F. Zone of Active Excavation: Area located within a radial distance about a surface point immediately above the face of excavation equal to the depth to the bottom of the excavation.
G. Critical Structure: Any building, structure, bridge, pier, or similar construction partially or entirely located within a zone of active excavation.

1.5 TUNNEL SUBMITTALS:
A. The following submittals are required for each the water and sewer:
   1. Tunneling Methodology: A brief description of proposed tunnel methodology for review. The description should be sufficient to convey the following:
      a. Proposed method of tunnel construction and type of face support.
      b. Manufacturer and type of tunnelling equipment proposed; type of lighting and ventilation systems.
      c. Number and duration of shifts planned to be worked each day.
      d. Sequence of operations.
      e. Locations of access shafts and work sites.
      f. Method of spoil transportation from the face, surface storage and disposal location.
      g. Capacity of jacking equipment and type of cushioning.
      h. Identify critical utility crossings and special precautions proposed.
2. Drawings and Calculations: Submit for record purposes, drawings, and calculations for any tunnel support system designed by the Contractor. Drawings shall be adequate for construction and include installation details. For pipe jacking and microtunneling, show pipe and pipe joint detail. Documents must be signed and sealed by a Professional Engineer registered in the State of Texas. Calculations shall include clear statement of criteria used for the design as described in Paragraph 1.6, Design Criteria.

3. Quality Control: Submit for review a brief description of quality control methods including:
   a. Method and frequency of survey control.
   b. Example of tunnel daily log.

4. Geotechnical Investigation: When geotechnical investigations are conducted by the Contractor, submit results to the Owner’s Engineer for record purposes.

5. Monitoring Plans:
   a. Instrumentation Monitoring Plan: Submit for review, prior to construction, a monitoring plan that includes a schedule of instrumentation design, layout of instrumentation points, equipment installation details, manufacturer’s catalog literature, and monitoring report forms.
   b. Surface Settlement Monitoring Plan: Submit a settlement monitoring plan for review prior to construction. The plan shall identify the location of settlement monitoring points, reference benchmarks, survey frequency and procedures, and reporting formats.

6. Structures Assessment: Preconstruction and postconstruction assessment reports shall be provided for critical structures, namely those located within the zone of active excavation from the proposed tunnel centerline. Photographs or a video of any existing damage to structures in the vicinity of the sewer alignment shall be included in the assessment reports.

7. The readings of all monitoring shall be submitted to the Owner’s Engineer.

8. Daily Reports: The shift log as defined in Paragraph 3.4, Pipe-jacked Tunneling Data, subparagraph 3.4A, shall be maintained by the Contractor, and must be made available to the Owner’s Engineer on request.

1.6 DESIGN CRITERIA:

A. Contractor is responsible for selection of the appropriate pipe and pipe joints to carry the thrust of any jacking forces or other construction loads in combination with overburden, earth and hydrostatic loads. Design of any pipe indicated on the Drawings considers in place loads only and does not take into account any construction loads. The criteria for longitudinal loading (jacking forces) on the pipe and joints shall be determined by the Contractor, based on the selected method of construction.

B. The jacked pipe shall be designed to withstand the thrust from the MTBM, TBM or shield and pipe advance without damage or distortion. The propulsion jacks shall be configured so that the thrust is uniformly distributed and will not damage or distort the pipe.

C. Take into account loads from handling and storing.

D. The criteria to be used at railroad crossings shall be Cooper E-80 locomotive loading distributions in accordance with AREA specifications for culverts. In the design, account for additive loadings due to multiple tracks.
E. The criteria to be used for truck loading shall be HS-20 vehicle loading distributions in accordance with AASHTO.

F. Provide pipes of diameter shown on the Drawings. Substitution of pipe with larger diameter to suit MTBM or TBM equipment availability will only be permitted if the Contractor can demonstrate to the Owner's Engineer's satisfaction that design flows and velocities can be achieved.

PART 2 - PRODUCTS

2.1 WATER PIPE:

A. Contractor shall be responsible for selecting appropriate pipes and pipe joints to safely carry the loads imposed during construction, including jacking forces. Pipe joints shall be flush with the outside pipe face when the pipes are assembled. Pipe materials shall be selected by Contractor from the following:


C. Use pipe that is round with a smooth, even outer surface, and has joints that allow for easy connections between pipes. Pipe ends shall be designed so that jacking loads are evenly distributed around the entire pipe joint and such that point loads will not occur when the pipe is installed. Pipe used for pipe jacking shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in-place loading conditions. Protect the driving ends of the pipe and joints against damage.

2.2 SEWER PIPE:

A. Contractor shall be responsible for selecting appropriate pipes and pipe joints to safely carry the loads imposed during construction, including jacking forces. Pipe joints shall be flush with the outside pipe face when the pipes are assembled. Pipe materials shall be selected by Contractor from the following:


C. Use pipe that is round with a smooth, even outer surface, and has joints that allow for easy connections between pipes. Pipe ends shall be designed so that jacking loads are evenly distributed around the entire pipe joint and such that point loads will not occur when the pipe is installed. Pipe used for pipe jacking shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in-place loading conditions. Protect the driving ends of the pipe and joints against damage.

PART 3 - EXECUTION

3.1 CONSTRUCTION OPERATIONS CRITERIA:

A. Use methods for microtunneling and pipe-jacked tunneling operations that will minimize ground settlement. Select a method which will control flow of water and prevent loss of soil into the tunnel and provide stability of the face under anticipated conditions.

B. Conduct tunneling operations in accordance with applicable safety rules and regulations, OSHA standards and Contractor's safety plan. Use methods, which include due regard for safety of workmen, adjacent structures, utilities, and the public.
C. Maintain clean working conditions wherever there is man access.

D. For tunneling under railroad embankments, highways, or streets, perform the installation so as to avoid interference with the operation of the railroads, highways, or streets, except as approved by the owner of the facility.

3.2 GROUND WATER CONTROL:

A. Provide ground water control measures in conformance when necessary to perform the work.

3.3 EQUIPMENT:

A. Full directional guidance of a shield, TBM, or MTBM is a prerequisite of this method of construction.

B. The Contractor shall be responsible for selection of tunneling equipment which, based on past experience, has proven to be satisfactory for excavation of the soils to be encountered.

C. The Contractor shall employ tunneling equipment that will be capable of handling the various anticipated ground conditions and is capable of minimizing loss of soil ahead of and around the machine and shall provide satisfactory support of the excavated face.

D. Tunnel Boring Machine (TBM): A TBM used for pipe jacking shall conform to the shape of the tunnel with a uniform perimeter that is free of projections that could produce over-excavation or voids. An appropriately sized overcutting bead may be provided to facilitate steering. In addition, it shall:

1. Be capable of full-face closure.
2. Be equipped with appropriate seals to prevent loss of bentonite lubricant.
3. Be capable of correcting roll by reverse drive or fins.
4. Be designed to handle adverse ground conditions including ground water ingress.
5. Be equipped with visual display to show the operator actual position of TBM relative to design reference.

E. Tunnel Shield: If a hand shield is used for pipe-jacked tunneling (with or without attached mechanized excavating equipment), the shield must be capable of handling the various anticipated ground conditions. In addition, the shield shall:

1. Conform to the shape of the tunnel with a uniform perimeter that is free of projections that could produce over-excavation or voids. An appropriately sized overcutting bead may be provided to facilitate steering.
2. Be designed to allow the face of the tunnel to be closed by use of gates or breasting boards without loss of ground.

F. Microtunneling Equipment: In the case of MTBM, use a spoil transportation system which:

1. Either balances the soil and ground water pressures by the use of a slurry or earth pressure balance system; system shall be capable of adjustments required to maintain face stability for the particular soil condition and shall monitor and continuously balance the soil and ground water pressure to prevent loss of slurry or uncontrolled soil and ground water inflow, or, in the case of a slurry spoil transportation system:
a. Provides pressure at the excavation face by use of the slurry pumps, pressure control valves, and a flow meter.

b. Includes a slurry bypass unit in the system to allow the direction of flow to be changed and isolated, as necessary.

c. Includes a separation process. Design it to provide adequate separation of the spoil from the slurry so that slurry with a sediment content within the limits required for successful tunneling can be returned to the cutting face for reuse. Appropriately contain spoil at the site prior to disposal.

d. Uses the type of separation process suited to the size of tunnel being constructed, the soil type being excavated, and the workspace available at each work area for operating the plant.

e. Allows the composition of the slurry to be monitored to maintain the slurry weight and viscosity limits required.

2. In the case of a cased auger earth pressure balance system, the system shall be capable of adjustments required to maintain face stability for the particular soil condition to be encountered. Monitor and continuously balance the soil and ground water pressure to prevent loss of soil or uncontrolled ground water inflow.

a. In a cased auger spoil transportation system, manage the pressure at the excavation face by controlling the volume of spoil removal with respect to the advance rate. Monitor the speed of rotation of the auger flight, and the addition of water.

3. Remote Control System: Provide an MTBM, which includes a remote-control system with the following features:

a. Allows for operation of the system without the need for personnel to enter the tunnel. Has a display available to the operator, at a remote operation console, showing the position of the shield in relation to a design reference together with other information such as face pressure, roll, pitch, steering attitude, valve positions, thrust force, and cutter head torque; rate of advance and installed length.

b. Integrates the system of excavation and removal of spoil and its simultaneous replacement by pipe. As each pipe section is jacked forward, the control system shall synchronize all the operational functions of the system.

4. Active Direction Control: Provide an MTBM, which includes an active direction control system with the following features:

a. Controls line and grade by a guidance system that relates the actual position of the MTBM to a design reference (e.g., by a laser beam transmitted from the jacking shaft along the pipe to a target mounted in the shield).

b. Provides active steering information, which shall be monitored and transmitted to the operating console.

c. Provides positioning and operation information to the operator on the control console.

5. Use generator, which is suitably insulated for noise “hospital” type, in residential or commercial areas.

G. Pipe Jacking Equipment: Provide a pipe jacking system with the following features:

1. Has the main jacks mounted in a jacking frame located in the starting shaft.
2. Has a jacking frame, which successively pushes a string of, connected pipes following the tunneling excavation equipment towards a receiving shaft.

3. Has sufficient jacking capacity to push the tunneling excavation equipment and the string of pipe through the ground. Incorporates intermediate jacking stations, if required.

4. Has a capacity at least 20 percent greater than the calculated maximum jacking load.

5. Develops a uniform distribution of jacking forces on the end of the pipe by use of spreader rings and packing, measured by operating gauges.

6. Provides and maintains a pipe lubrication system at all times to lower the friction developed on the surface of the pipe during jacking.

7. Jack Thrust Reactions: Use reactions for pipe jacking that is adequate to support the jacking pressure developed by the main jacking system. Special care shall be taken when setting the pipe guide rails in the jacking shaft to ensure correctness of the alignment, grade, and stability.

H. Air Quality: Provide equipment to maintain proper air quality of manned tunnel operations during construction in accordance with OSHA requirements.

I. Enclose lighting fixtures in watertight enclosures with suitable guards. Provide separate circuits for lighting, and other equipment.

J. Electrical systems shall conform to requirements of National Electrical Code - NFPA70.

3.4 PIPE-JACKED TUNNELING DATA:

A. Maintain shift logs of construction events and observations. The Owner’s Engineer shall have access to the Contractor’s logs with regard to the following information:

1. Location of boring machine face or shield by station and progress of tunnel drive during shift.
2. Hours worked per shift on tunneling operations.
3. Completed field forms for checking line and grade of the tunneling operation, showing achieved tolerance relative to design alignment. Steering control logs will generally be acceptable.
4. Maximum pipe jacking pressures per drive.
5. Location, elevation and brief soil descriptions of soil strata.
6. Ground water control operations and piezometric levels.
7. Observation of any lost ground or other ground movement.
8. Any unusual conditions or events.
9. Reasons for operational shutdown in the event a drive is halted.

3.5 EXCAVATION AND JACK OF PIPE:

A. Tunnel Excavation:

1. Keep tunnel excavation within the easements and rights-of-way indicated on the Drawings and to the lines and grades designated on the Drawings.
2. Perform tunneling operations in a manner that will minimize the movement of the ground in front of and surrounding the tunnel. Prevent damage to structures and utilities above and in the vicinity of the tunneling operations.
3. Open-face excavations:

   a. Keep the face breasted or otherwise supported and prevent falls, excessive raveling, or erosion. Maintain standby face supports for immediate use when needed.
b. During shutdown periods, support the face of the excavation by positive means; no support shall rely solely on hydraulic pressure.

4. Closed-face excavation:
   a. Carefully control volume of spoil removed. Advance rate and excavation rate to be compatible to avoid over excavation or loss of ground.
   b. When cutting head is withdrawn or is open for any purpose, keep excavated face supported and stabilized.

5. Excavated diameter should be a minimum size to permit pipe installation by jacking with allowance for bentonite injection into the annular space.

6. Whenever there is a condition encountered which could endanger the tunnel excavation or adjacent structures, operate without intermission including 24-hour working, weekends and holidays, until the condition no longer exists.

7. The Contractor shall be responsible for damage due to settlement from any construction-induced activities.

B. Pipe Jacking:
   1. Cushion pipe joints as necessary to transmit the jacking forces without damage to the pipe or pipe joints.
   2. Maintain an envelope of bentonite slurry around the exterior of the pipe during the jacking and excavation operation to reduce the exterior friction and possibility of the pipe seizing in place.
   3. If the pipe seizes up in place and the Contractor elects to construct a recovery access shaft, obtain approval from the Owner’s Engineer. Coordinate traffic control measures and utility adjustments as necessary prior to commencing work.
   4. In the event a section of pipe is damaged during the jacking operation, or joint failure occurs, as evidenced by inspection, visible ground water inflow or other observations, the Contractor shall submit for approval his methods for repair or replacement of the pipe.

C. Grouting: Grouting requirements are defined in Section 317300- Tunnel Grouting.

3.6 CONTROL OF LINE AND GRADE:

A. Construction Control:
   1. The Owner’s Engineer will establish the baselines and benchmarks indicated on the Drawings. Contractor shall check baselines and benchmarks at the beginning of the Work and report any errors or discrepancies to the Owner’s Engineer.
   2. Use the baselines and benchmarks established by the Owner’s Engineer to establish and maintain construction control points, reference lines and grades for locating tunnel, sewer pipe, and structures.
   3. Establish construction control points sufficiently far from the work so as not to be affected by ground movement caused by pipe-jacked tunneling operations.

B. Benchmark Movement: The Contractor shall ensure that if settlement of the ground surface occurs during construction which affects the accuracy of the temporary benchmarks the Contractor shall detect and report such movement and reestablish temporary benchmarks. Advise the Owner’s Engineer of any settlement affecting the permanent monumentation benchmarks.

C. Line and Grade:
1. Check and record the survey control for the tunnel against an above-ground undisturbed reference at least once for each 250 feet of tunnel constructed.

2. Record the exact position of the MTBM or TBM or shield after each shove to ensure the alignment is within specified tolerances. Make immediate correction to alignment before allowable tolerances are exceeded.

3. When excavation is offline or grade, make alignment corrections to avoid reverse grades in gravity sewers.

4. Acceptance criteria for the sewer pipe shall be plus or minus 6 inches in horizontal alignment from the theoretical at any point between manholes, including the receiving end, and plus or minus 1-1/2 inches in elevation from the theoretical.

5. Pipe installed outside tolerances and subsequently abandoned shall first be fully grouted.

3.7 MONITORING:

A. Instrumentation Monitoring: Instrumentation requirements are shown on the Drawings. Instrumentation specified shall be accessible at all times to the Owner’s Engineer. Readings shall be submitted promptly to the Owner’s Engineer.

1. Install and maintain an instrumentation system to monitor and detect movement of the ground surface and adjacent structures. Establish vertical control points at a distance from the construction areas that avoids disturbance due to ground settlement.

2. Installation of the instrumentation shall not preclude the Owner’s Engineer, through an independent contractor or consultant, from installing instrumentation in, on, near, or adjacent to the construction work. Access shall be provided to the work for such independent installations.

3. Instruments shall be installed in accordance with the Drawings and the manufacturer’s recommendations.

B. Surface Settlement Monitoring:

1. Establish monitoring points on all critical structures.

2. Record location of settlement monitoring points with respect to construction baselines and elevations. Record elevations to an accuracy of 0.01 feet for each monitoring point location. Monitoring points should be established at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.

3. Ground surface elevations shall be recorded on the centerline ahead of the tunneling operations at a minimum of 100-foot intervals or at least three locations per tunnel drive. For sewers greater than 60-inch diameter, also record similar data at approximately 20 feet each side of the centerline. Settlement monitoring points must be clearly marked by studs or paint for ease of locating.

4. Railroads: Monitor ground settlement of track subbase at centerline of each track.

5. Utilities and Pipelines: Monitor ground settlement directly above and 10 feet before and after the utility or pipeline intersection.

C. Reading Frequency and Reporting: The Contractor shall submit to the Owner’s Engineer, records of readings from the various instruments and survey points.

1. Instrumentation monitoring results to be read at the frequency specified and unless otherwise specified, shall be started prior to the zone of active excavation reaching that point, and shall be continued until the zone of active excavation has passed and until no further detectable movement occurs.
2. Surface settlement monitoring readings shall be taken:
   a. Prior to the zone of active excavation reaching that point,
   b. When the tunnel face reaches the monitoring point (in plan), and
   c. When the zone of active excavation has passed, and no further movement is detected.

3. All monitoring readings shall be submitted promptly to the Owner's Engineer.
4. Immediately report to the Owner's Engineer any movement, cracking, or settlement which is detected.
5. Following substantial completion but prior to final completion, make a final survey of all monitoring points.

3.8 DISPOSAL OF EXCESS MATERIAL:
   A. Remove spoil in accordance with plans, specifications, local, and state regulations.

END OF SECTION 330507.36
SECTION 330531.13 - POLYVINYL CHLORIDE PRESSURE PIPE

PART 1 - GENERAL

1.1 Summary:

A. Section Includes

1. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.
2. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 60 inches.
3. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

B. Related Sections:

1. Site Water Utility Distribution Piping – Section 331416
2. Site Sanitary Sewerage Gravity Piping – Section 333116
3. Sanitary Sewerage Force Main Piping – Section 333123
4. Trenching and Backfilling – Section 312333

1.2 MEASUREMENT AND PAYMENT:

A. Unit Prices.

1. No separate payment will be made for PVC pipe under this Section. Include cost in unit price for work included as specified in the following sections:
2. Section 331416 – Site Water Utility Distribution Piping
3. Section 333116 – Site Sanitary Sewerage Gravity Piping
4. Section 333123 – Sanitary Sewerage Force Main Piping

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES:


I. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

J. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.


O. ASTM F 794 - Standard for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.


S. AWWA C 900-16 or latest revision - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches Through 60 Inches (100 mm through 1500 mm).

T. AWWA C 909 - Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. Through 24 In. (100 mm Through 600 mm) for Water, Wastewater, and Reclaimed Water Service

U. AWWA M23 – PVC Pipe – Design and Installation


1.4 SUBMITTALS:

A. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

B. Product Data. Manufacturer product description sheets with design data including but not limited to specific pipe material, dimensions, and pressure rating.

C. Calculations and limits of thrust restraint shall be based on AWWA M23, latest edition.

1.5 QUALITY CONTROL:

A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909, and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.

B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909, and AWWA C 905, and this Section.

C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from another source is not acceptable. Furnish copies of test reports to Project Manager for review. Cost of testing paid by Contractor.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.

B. Furnish PVC pressure pipe manufactured from Class 12454 virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 °F per requirements of PPI TR3. Provide pipe, which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.

C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.

   1. Pipe Material:
      a. DR 18: For restrained joints where shown on Drawings.
      b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVS in potentially petroleum contaminated areas.

D. Water Service.
1. Provide self-extinguishing PVC pipe that bears Underwriters’ Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.

2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).

E. Gaskets:

1. Gasket materials shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.


3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.

F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.

G. Do not use PVC in potentially or known contaminated areas.

H. Do not use PVC in areas of exposed direct sunlight.

2.2 WATER SERVICE PIPE:

A. Pipe 4-inch through 60-inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

B. Provide Polyvinyl Chloride Pipe from approved manufacturers.

C. Make curves and bends by offsetting (i.e., deflecting joints). Do not exceed maximum offset recommended by pipe manufacturer or the City, whichever is less.

D. Hydrostatic Test: AWWA C 900, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer’s written certification.
2.3 GRAVITY SEWER PIPE:

A. PVC gravity sanitary sewer pipe shall be in accordance with provisions in following table:

<table>
<thead>
<tr>
<th>WALL CONSTRUCTION</th>
<th>ASTM DESIGNATION</th>
<th>SDR (MAX.)/STIFFNESS (MIN.)</th>
<th>DIAMETER SIZE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>D3034</td>
<td>SDR 26 / PS 115</td>
<td>6” to 10”</td>
</tr>
<tr>
<td></td>
<td>D3034</td>
<td>SDR 35 / PS 46</td>
<td>12” &amp; 15”</td>
</tr>
<tr>
<td></td>
<td>F679</td>
<td>SDR 35 / PS 46</td>
<td>18” to 60”</td>
</tr>
<tr>
<td></td>
<td>AWWA C900-16</td>
<td>DR 18 / N/A</td>
<td>4” to 60”</td>
</tr>
<tr>
<td></td>
<td>AWWA C909</td>
<td>DR 18 / N/A</td>
<td>4” to 24”</td>
</tr>
</tbody>
</table>

B. PVC storm sewer pipe shall be in accordance with provisions in following table:

<table>
<thead>
<tr>
<th>WALL CONSTRUCTION</th>
<th>MANUFACTURER</th>
<th>ASTM DESIGNATION</th>
<th>SDR (MAX.)/STIFFNESS (MIN.)</th>
<th>DIAMETER SIZE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>J-M Pipe</td>
<td>D3034</td>
<td>SDR 26 / PS 115</td>
<td>6” to 10”</td>
</tr>
<tr>
<td></td>
<td>CertainTeed</td>
<td>D3034</td>
<td>SDR 35 / PS 46</td>
<td>12” &amp; 15”</td>
</tr>
<tr>
<td></td>
<td>Diamond</td>
<td>F679</td>
<td>SDR 35 / PS 46</td>
<td>18” to 27”</td>
</tr>
<tr>
<td></td>
<td>Uponor ETI</td>
<td>AWWA C900-16</td>
<td>DR 18 / N/A</td>
<td>4” to 60”</td>
</tr>
<tr>
<td></td>
<td>North American</td>
<td>AWWA C909</td>
<td>DR 18 / N/A</td>
<td>4” to 24”</td>
</tr>
<tr>
<td></td>
<td>Truss (Gasketed)</td>
<td>Contech</td>
<td>D2680</td>
<td>200 psi</td>
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<tr>
<td></td>
<td></td>
<td>Contech A-2000</td>
<td>F949</td>
<td>46 psi</td>
</tr>
<tr>
<td>Profile</td>
<td></td>
<td>Contech A-2026</td>
<td>F949</td>
<td>115 psi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ETI, Ultra-Rib</td>
<td>F794</td>
<td>46 psi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ETI, Ultra-Corr</td>
<td>F794</td>
<td>46 psi</td>
</tr>
</tbody>
</table>
C. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe stiffness of 115 psi.

D. For sewers up to 12-inch diameter crossing over water lines or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.

E. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded or otherwise held in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.

F. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded, or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

G. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Project Manager. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified. This is a brief summary of the test method, and the full current edition of the standard must be followed.

H. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36-inch, test three specimens, each a minimum of 12 inch (305 mm) in length. This is a brief summary of the test method, and the full current edition of the standard must be followed.

I. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.03F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test. This is a brief summary of the test method, and the full current edition of the standard must be followed.

J. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third-party certification for joint testing each diameter of storm sewer pipe. This is a brief summary of the test method, and the full current edition of the standard must be followed.

K. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

L. Saddle for pipe with 0.5-inch width and greater: Connect side sewer by drilling proper size round hole in wall of the main sewer pipe, inserting an approved pipe compression saddle. The Saddle shall meet requirements of ASTM C-923. Saddles will accept 4-inch, 6-inch, and
8-inch pipe. The lateral pipe shall be held in place by one stainless steel compression band with stainless steel nut and bolt (any AISI Series 300) type tightening device and meeting requirements of ASTM A240. A stainless-steel shear band shall wrap around the pipe a minimum of 380 degrees. Saddle may not protrude into mainline pipe.

2.4 SANITARY SEWER FORCE MAIN PIPE:

A. Provide approved PVC pressure pipe conforming to requirements for water service pipe and conforming to minimum working pressure rating specified in Section 333123 – Sanitary Sewerage Force Main Piping.

B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.

C. Fittings: Provide approved ductile iron fittings as per Section 331111.12 - Ductile Iron Piping and Fittings, Paragraph 2.4, except furnish fittings with one of following approved internal linings:

1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting.
2. Nominal 40 mils (35 mils minimum) polyurethane.
3. Nominal 40 mils (35 mils minimum) ceramic epoxy
4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy

D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings. Test pressure rated pipe in accordance with Paragraph 2.2E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE:

A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 psi and 200 psi may be provided for up to 12-inches in diameter (water or sanitary).

B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

PART 3 - EXECUTION

3.1 PROTECTION

A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer’s recommendations.

3.2 INSTALLATION

A. Conform to requirements of Section 331416 – Site Water Utility Distribution Piping, Section 333116- Site Sanitary Sewerage Gravity Piping, and Section 333123 - Sanitary Sewerage Force Main Piping, as applicable.

B. Install PVC pipe in accordance with Section 312333 – Trenching and Backfilling, ASTM D 2321 for Sewer Pipe, and manufacturer’s recommendations.
C. Install PVC water service pipe to clear utility lines with minimum 6-inch separation, unless otherwise shown on Drawings:

D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.

E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support. Ensure barrel is fully supported along entire length of pipe, prior to backfilling.

F. For PVC pipe installed by trenchless methods, provide integral restrained joints and pull pipe through hole or casing. For PVC pipe pushed through hole or casing, provide approved bell insertion protection system.

G. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.

H. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

I. Pipe Assembly Procedures

1. Do not remove gasket from pipe.
2. Lay pipe by inserting spigot end into bell flush with the insertion line or as recommended by pipe manufacturer.
3. Do not assemble joint by swinging or stabbing.
4. Do not assemble joint using machinery or equipment such as backhoe bucket.
5. At no time shall spigot go past insertion line or homing mark. Continuously observe and check each homing mark for proper length and install pipe with home mark visible.

3.3 PVC RESTRAINED MECHANISM:

A. For low-profile coupling with spline-type joints:

1. Do not apply lubricant to spline or pipe or coupling spline grooves.
2. Do not use excessive force while inserting the spline through coupling.
3. Insert spline until it is fully seated around circumference of pipe.

B. Field Cutting of Pipe Ends:

1. Perform by workers certified by manufacturer.
2. Use a PVC pipe cutter and provide square ends.
3. Follow manufacturer’s recommendation to disassemble restrained joint after it has been locked in place.
4. For low-profile coupling with spline-type joints, use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION 330531.13
SECTION 330531.19 - FUSIBLE POLYVINYL CHLORIDE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION:

A. SCOPE

1. This section specifies fusible polyvinylchloride pipe, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling and storage.

B. PIPE DESCRIPTION

1. Pipe supplier shall furnish fusible polyvinylchloride pipe conforming to all standards and procedures and meeting all testing and material properties as specified in this specification.

1.2 QUALITY ASSURANCE:

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of design, bid, or construction, whichever is earliest. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

C. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

1.3 REFERENCES

A. ANSI/AWWA C110/A21.12 (or latest revision) – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids

B. ANSI/AWWA C111/A21.17 (or latest revision) – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings


E. ANSI/AWWA C606-15 (or latest revision) - AWWA Standard Grooved and Shouldered Joints

F. ANSI/AWWA C651 05 (or latest revision) – AWWA Standard for Disinfecting Water Mains.

G. ANSI/AWWA C900-16 (or latest revision) – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100mm Through 1500mm), for Water Distribution.


K. ASTM D1785 – Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.


M. ASTM D2241 – Poly 9Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)


O. ASTM D3034 – Standard Specifications for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

P. ASTM F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe


T. UNI-B-6 UNI-PUB-08 NSF-14 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe Tapping Guide for PVC Pressure Pipe


V. PPI TR-2 – PVC Range Composition Listing of Qualified Ingredients

1.4 MANUFACTURER REQUIREMENTS:

A. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
1.5 FUSION TECHNICIAN REQUIREMENTS:

A. Fusion Technician shall be fully qualified by the pipe supplier to install fusible polyvinylchloride pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

1.6 SPECIFIED PIPE SUPPLIERS:

A. Fusible polyvinylchloride pipe shall be used as manufactured under the trade names Fusible C-900®, and FPVC®, for Underground Solutions, Inc., Poway, CA, (858) 679-9551. Fusion process shall be as patented by Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051. Owner and engineer are aware of no other supplier of fusible polyvinylchloride pipe that is an equal to this specified pipe supplier and products.

1.7 WARRANTY:

A. The pipe shall be warranted for one year per the pipe supplier’s standard terms.

B. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per the fusion service provider’s standard terms.

1.8 PRE-CONSTRUCTION SUBMITTALS:

A. The following PRODUCT DATA is required from the pipe supplier and/or fusion provider:

1. Pipe Size
2. Dimensionality
3. Pressure Class per applicable standard
4. Color
5. Recommended Minimum Bending Radius
6. Recommended Maximum Safe Pull Force
7. Fusion technician qualification indicating conformance with this specification.

1.9 POST-CONSTRUCTION SUBMITTALS:

A. The following AS-RECORDED DATA is required from the contractor and/or fusion provider to the owner or pipe supplier upon request:

1. Approved datalogger device reports
2. Fusion joint documentation containing the following information:
   a. Pipe Size and Thickness
   b. Machine Size
   c. Fusion Technician Identification
   d. Job Identification
   e. Fusion Joint Number
   f. Fusion, Heating, and Drag Pressure Settings
   g. Heat Plate Temperature
   h. Time Stamp
   i. Heating and Cool Down Time of Fusion
   j. Ambient Temperature
PART 2 - PRODUCTS

2.1 FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR POTABLE WATER:

A. Fusible polyvinylchloride pipe shall conform to AWWA C900,

B. ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.

C. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

D. Fusible polyvinylchloride pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.

E. Fusible polyvinylchloride pipe shall be blue in color for potable water use.

F. Pipe shall be marked as follows:

1. Nominal pipe size
2. PVC
3. Dimension Ratio, Standard Dimension Ratio, or Schedule
4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
6. NSF-61 mark verifying suitability for potable water service
7. Extrusion production-record code
8. Trademark or trade name
9. Cell Classification 12454 and/or PVC material code 1120 may also be included

G. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.2 FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR NON-POTABLE WATER NOT CONFORMING TO AWWA C900 DIMENSIONALITY:

A. Fusible polyvinylchloride pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standard.

B. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

C. Fusible polyvinylchloride pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.

D. Fusible polyvinylchloride pipe shall be purple in color for reclaim, reuse, or other non-potable water distribution or conveyance.

E. Pipe shall be marked as follows:

1. Nominal pipe size
2. PVC
3. Dimension Ratio, Standard Dimension Ratio, or Schedule
4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
6. Extrusion production-record code
7. Trademark or trade name
8. Cell Classification 12454 and/or PVC material code 1120 may also be included
9. For reclaim water service, the wording: “Reclaimed Water, NOT for Potable Use”

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.3 FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR NON-POTABLE WATER CONFORMING TO AWWA C900 DIMENSIONALITY:

A. Fusible polyvinylchloride pipe shall conform to AWWA C900 standard.

B. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

C. Fusible polyvinylchloride pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.

D. Fusible polyvinylchloride pipe shall be purple in color for reclaim, reuse, or other non-potable water distribution or conveyance.

E. Pipe shall be marked as follows:
   1. Nominal pipe size
   2. PVC
   3. Dimension Ratio, Standard Dimension Ratio, or Schedule
   4. AWWA pressure class
   5. AWWA standard designation number
   6. Extrusion production-record code
   7. Trademark or trade name
   8. Cell Classification 12454 and/or PVC material code 1120 may also be included
   9. For reclaim water service, the wording: “Reclaimed Water, NOT for Potable Use”

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.4 FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR WASTEWATER NOT CONFORMING TO AWWA C90 DIMENSIONALITY:

A. Fusible polyvinylchloride pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standard.

B. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
C. Fusible polyvinylchloride pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.

D. Fusible polyvinylchloride pipe shall be green in color for wastewater use.

E. Pipe shall be marked as follows:
   1. Nominal pipe size
   2. PVC
   3. Dimension Ratio, Standard Dimension Ratio, or Schedule
   4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
   5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
   6. Extrusion production-record code
   7. Trademark or trade name
   8. Cell Classification 12454 and/or PVC material code 1120 may also be included

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.5 FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR WASTEWATER CONFORMING TO AWWA C900 DIMENSIONALITY:

A. Fusible polyvinylchloride pipe shall conform to AWWA C900 standard.

B. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

C. Fusible polyvinylchloride pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.

D. Fusible polyvinylchloride pipe shall be green in color for wastewater use.

E. Pipe shall be marked as follows:
   1. Nominal pipe size
   2. PVC
   3. Dimension Ratio, Standard Dimension Ratio, or Schedule
   4. AWWA pressure class
   5. AWWA standard designation number
   6. Extrusion production-record code
   7. Trademark or trade name
   8. Cell Classification 12454 and/or PVC material code 1120 may also be included

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.6 FUSIBLE POLYVINYLCHLORIDE NON-PRESSURE PIPE FOR WASTEWATER OR SURFACE WATER:

A. Fusible polyvinylchloride pipe shall conform to ASTM D3034 or ASTM F679.
B. Fusible polyvinylchloride pipe may instead conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable.

C. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

D. Fusible polyvinylchloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.

E. Fusible polyvinylchloride pipe shall be green in color for wastewater use. Fusible polyvinylchloride pipe shall be white in color for surface or storm water use.

F. Pipe shall be marked as follows:
   1. Nominal pipe size
   2. PVC
   3. Dimension Ratio, Standard Dimension Ratio, or Schedule
   4. Pressure class or standard pressure rating
   5. Standard designation number or pipe type
   6. Extrusion production-record code
   7. Trademark or trade name
   8. Cell Classification 12454 and/or PVC material code 1120 may also be included

G. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.7 FUSION JOINTS:

A. Unless otherwise specified, fusible polyvinylchloride pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

2.8 CONNECTIONS AND FITTINGS FOR PRESSURE APPLICATIONS:

A. Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.

B. DUCTILE IRON MECHANICAL AND FLANGED FITTINGS

1. Acceptable fittings for use with fusible polyvinylchloride pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

2. Connections to fusible polyvinylchloride pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.

3. Bends, tees and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.

4. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

5. If required, linings for Ductile Iron fittings shall meet the following requirements for the following service environments:
a. Wastewater:
   1) Ceramic Epoxy shall be Tnemec Perma-Shield 431.
   2) Polyurethane shall be DuraShield 210 or 310.

b. Potable Water:
   1) Liquid Epoxy shall be 100% solids liquid epoxy, Tnemec Epoxyline Series FC22.
   2) Polyurethane shall be DuraShield 210-61 or 310-61.

6. If required, coatings for Ductile Iron fittings shall meet the following requirements for buried and/or immersion service duty:
   a. Polyurethane shall be DuraShield 210 or 310.
   b. Liquid Epoxy shall be 100% solids liquid epoxy, Tnemec Epoxyline Series FC22.
   c. Coal tar epoxy shall be Sherwin Williams Targuard.

C. PVC GASKETED, PUSH-ON FITTINGS

1. Acceptable fittings for use with fusible polyvinylchloride pipe shall include standard PVC pressure fittings conforming to AWWA C900.
2. Acceptable fittings for use joining fusible polyvinylchloride pipe other sections of fusible polyvinylchloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the drawings.
3. Bends, tees and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.
4. PVC gasketed, push-on fittings and mechanical restraints, if used, must be installed per the manufacturer’s guidelines.

D. FUSIBLE POLYVINYL CHLORIDE SWEEPS OR BENDS

1. Fusible polyvinyl chloride sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined using the sweep or bend.
2. Fusible polyvinyl chloride sweeps or bends shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible polyvinyl chloride sweep.
3. Standard fusible polyvinyl chloride sweeps or bend angles shall not be greater than 22.5 degrees and shall be used in nominal diameters ranging from 4 inches through 16 inches.

E. SLEEVE-TYPE COUPLINGS

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe and may be restrained or unrestrained as indicated in the construction documents.
2. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.
F. EXPANSION AND FLEXIBLE COUPLINGS

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

2. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

G. CONNECTION HARDWARE

1. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.9 CONNECTIONS FOR GRAVITY SANITARY SEWER AND NON-PRESSURE APPLICATIONS

A. The following connections are to be used in conjunction with tie-ins to other non-pressure, gravity sewer piping and/or structures, and shall be as indicated in the construction documents.

B. PVC GASKETED, PUSH-ON COUPLINGS

1. Acceptable couplings for joining fusible polyvinylchloride pipe to other sections of fusible polyvinylchloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings as indicated in the construction documents.

2. PVC gasketed, push-on fittings and/or restraint hardware must be installed per the manufacturer’s guidelines.

C. FUSIBLE POLYVINYL CHLORIDE SWEEPS OR BENDS

1. Fusible polyvinyl chloride sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined using the sweep or bend.

2. Fusible polyvinyl chloride sweeps or bends shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible polyvinyl chloride sweep.

3. Standard fusible polyvinyl chloride sweeps or bend angles shall not be greater than 22.5 degrees and shall be used in nominal diameters ranging from 4 inches through 16 inches.

D. SLEEVE-TYPE COUPLINGS

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

E. EXPANSION AND FLEXIBLE COUPLINGS
1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

F. CONNECTION HARDWARE

1. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

G. CONNECTION TO SANITARY SEWER MANHOLES AND STRUCTURES

1. Fusible polyvinylchloride pipe shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.

2. Connections to existing manholes and structures shall be as indicated in the construction documents.

   a. For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
   b. For a knockout opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
   c. Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.

3. Connections to a new manhole or structure shall be as indicated in the construction documents.

   a. A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
   b. Drop connections shall be required where shown on drawings.
   c. Grout internal joint space with non-shrink grout.

PART 3 - EXECUTION

3.1 DELIVERY AND OFF-LOADING:

A. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.

B. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.

C. Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all the pipe supplier’s guidelines shall be followed.

D. Off-loading devices such as chains, wire rope, chokers, or another pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
E. During removal and handling, be sure that the pipe does not strike anything.

F. Significant impact could cause damage, particularly during cold weather.

G. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to ensure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

3.2 HANDLING AND STORAGE:

A. Any length of pipe showing a crack, or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the owner or engineer.

B. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.

C. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

D. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

E. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.

F. Pipe shall be stored and stacked per the pipe supplier’s guidelines.

3.3 FUSION PROCESS:

A. Fusible polyvinylchloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier’s guidelines.

B. Fusible polyvinylchloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.

C. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

D. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

1. HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater
controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier’s guidelines.

2. CARRIAGE – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

3. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.

4. DATA LOGGING DEVICE – An approved datalogging device with the current version of the pipe supplier’s recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

E. Other equipment specifically required for the fusion process shall include the following:

1. Pipe rollers shall be used for support of pipe to either side of the machine
2. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and/or windy weather, per the pipe supplier’s recommendations.
3. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
4. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
5. Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

F. JOINT RECORDING

1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician’s joint report.

3.4 GENERAL INSTALLATION:

A. Installation guidelines from the pipe supplier shall be followed for all installations.
B. The fusible polyvinylchloride pipe will be installed in a manner so as not to exceed the recommended bending radius.
C. Where fusible polyvinylchloride pipe is installed by pulling in tension, the recommended Safe Pulling Force established by the pipe supplier shall not be exceeded.

3.5 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS:

A. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:
1. Field verify location, size, piping material, and piping system of the existing pipe.
2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.

3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

B. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

3.6 PIPE SYSTEM CONNECTIONS:

A. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer’s guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer’s guidelines.

3.7 TAPPING FOR POTABLE AND NON-POTABLE WATER APPLICATIONS:

A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.

B. All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

C. Equipment used for tapping shall be made specifically for tapping PVC pipe:

1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. ‘Hole saws’ made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
2. Manually operated or power operated drilling machines may be used.

D. Taps may be performed while the pipeline is filled with water and under pressure (‘wet’ tap,) or when the pipeline is not filled with water and not under pressure (‘dry’ tap).

3.8 TESTING:

A. Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

B. HYDROSTATIC TESTING AND LEAKAGE TESTING FOR PRESSURE PIPING

1. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as fused PVC jointing shall comply with AWWA C605.
2. Unless agreed to or otherwise designated by the owner or engineer, for a simultaneous hydrostatic and leakage test following installation, a pressure equal to 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation shall be applied. The duration of the pressure test shall be for two (2) hours.
3. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
4. In preparation for pressure testing the following parameters must be followed:
a. All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by ‘flushing’ the pipeline in accordance with the parameters and procedures as described in AWWA C605.

b. The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer’s guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.

c. Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to minimize the amount of potentially trapped air in the pipeline.

C. LEAKAGE TESTING FOR NON-PRESSURE PIPING

1. Gravity sanitary sewers that contain mechanical jointing in addition to fused PVC joints may need to be tested for excessive leakage.

2. Gravity sanitary sewer leakage testing may include appropriate water or low-pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of two feet. The air test, if used, shall be conducted in accordance with one of the following Standards:

   a. ASTM F1417
   b. UNI-B-6

3. The testing method selected shall properly consider the existing groundwater elevations during the test.

D. DEFLECTION TESTING FOR NON-PRESSURE PIPING

1. After completion of the backfill, the engineer or owner may require that a deflection test be performed.

2. Deflection tests should be conducted using a go/no-go mandrel. The mandrel’s outside dimension shall be sized to permit no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. If the internal beading of the fused joints for the pipe is not required to be removed, the mandrel shall account for this clearance as well. The mandrel shall be approved by the owner or engineer prior to use. Lines that permit safe entry may allow other deflection test options, such as direct measurements.

E. DISINFECTION OF THE PIPELINE FOR POTABLE WATER PIPING

1. After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. Unless otherwise directed by the owner or engineer, the pipeline will be disinfected per AWWA C651.
F. PARTIAL TESTING

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer.

END OF SECTION 330531.19
SECTION 330561 - CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY:
A. Section Includes
   1. Concrete sanitary sewer manholes.
B. Related Sections
   1. Trenching and Backfilling – Section 312333

1.2 MEASUREMENT AND PAYMENT:
A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.
B. Payment for concrete manholes is on a unit price basis per manhole. Payment will be made for each manhole installed complete in place, including manhole, drop pipe, excavation, foundation, connection to sewer pipe, and backfill.
C. Each concrete manhole has a separate pay item identified by station, as shown on the Drawings.
D. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REFERENCES:
B. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
C. ASTM C 270 - Specification for Mortar for Unit Masonry.
F. ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
H. ASTM D 2996 - Specification for Filament-wound Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

J. AWWA C 213 - Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

1.4 SUBMITTALS:

A. Submit proposed design mix and test data for each type and strength of concrete.

B. Submit manufacturer’s data and details of following items for approval:
   1. Frames, grates, rings, and covers.
   2. Materials to be used in fabricating drop connections.
   3. Materials to be used for pipe connections at manhole walls.
   4. Materials to be used for stubs and stub plugs.
   5. Plugs to be used for sanitary sewer hydrostatic testing.

PART 2 - PRODUCTS

2.1 CONCRETE:

A. For extra-depth manholes, provide Class A concrete with minimum compressive strength of 4000 psi unless otherwise indicated on Drawings.

B. Precast and cast in place reinforced concrete manhole sections shall conform to the requirements of ASTM designation C-478. The precast sections shall be certified as to compressive strength, impermeability, and chemical resistance. Certification shall document corrosion resistance of the design mix for precast and cast in place manholes to fluids with a pH of two (2) or less in accordance with the performance requirements of ASTM C-267. Design mix shall include catalysts which generate non-soluble crystalline formation utilizing “Zype” or approved equal.

2.2 MORTAR:

A. Conform to requirements of ASTM C 270, Type S using Portland cement.

2.3 MISCELLANEOUS METALS:

A. Provide cast-iron frames, grates, rings, and covers.

2.4 DROP CONNECTIONS AND STUBS:

A. Drop connections and stubs shall conform to the same pipe material requirements used in the main pipe, unless otherwise indicated on the Drawings.

2.5 PIPE CONNECTIONS:

A. Provide resilient connectors conforming to requirements of ASTM C 923. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:
   1. External clamps: Type 304 stainless steel.
   2. Internal, expandable clamps on Standard manholes: Type 304 stainless steel.
3. 11-guage minimum.
4. Internal, expandable clamps on corrosion-resistant manholes:
   a. Type 316 stainless steel, 11-guage minimum, or
   b. Type 304 stainless steel, 11-guage minimum, coated with minimum 16-mil fusion-bonded epoxy conforming to AWWA C 213.

B. Where rigid joints between pipe and a cast-in-place manhole base are specified or shown on the Drawings, provide polyethylene-isoprene water stop meeting the physical property requirements of ASTM C 923, such as Pres-Seal WS Series, or approved equal.

C. Storm sewer pipe connections to concrete manholes shall be grouted in place, unless otherwise shown on the Drawings. Grout pipe penetration in place on both inside and outside of manhole.

2.6 SEALANT MATERIALS:
   A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, such as Adeka Ultraceal P 201, or approved equal.

2.7 CORROSION-RESISTANT MANHOLE MATERIALS:
   A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on the Drawings, provide one of the following:
      1. PVC liner for precast cylindrical manhole section, base sections, and cone sections.
      2. Precast base sections lined with PVC and fiberglass manhole sections and cone sections.

2.8 BACKFILL MATERIALS:
   A. Backfill materials shall conform to the requirements of Section 312323.13 - Backfill.

2.9 NON-SHRINK GROUT:
   A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based non-shrink grout requiring only the addition of water.
   B. Provide grout meeting requirements of ASTM C 1107 and having a minimum 28-day compressive strength of 7,000 psi.

2.10 VENT PIPES:
   A. Provide external vent pipes for manholes where indicated on the Drawings.
   B. Buried Vent Pipes: Provide 3-inch or 4-inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for the vent outlet assembly.
C. Vent Outlet Assembly: Provide a vent outlet assembly as shown on the Drawings, constructed of the following specified materials:

1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer’s recommendations.

2. Joints and Fittings: Provide epoxy-bodied fittings and join pipe to fittings with epoxy adhesive, according to the pipe manufacturer’s instructions.

3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on the Drawings. Flanges shall meet bolt pattern and dimensions for ANSI B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.

4. Coating: Provide a 2 component, aliphatic polyurethane coating, using a primer or tie coat recommended by the manufacturer. Provide two or more coats to yield a dry film thickness of at least 3 mils. Provide Amershiel, Tnemec 74, or approved equal. The City Engineer from the manufacture’s standard colors shall select color.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify lines and grades are correct.

B. Determine if the subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. If it cannot be compacted to that density, the subgrade shall be moisture conditioned until that density can be reached or shall be treated as an unstable subgrade.

C. Do not build sanitary sewer manholes in ditches, swales, or drainage paths unless approved by the Owner.

3.2 MANHOLES:

A. Construct manholes to dimensions shown on Drawings. Commence construction as soon as possible after pipes are laid. On monolithic sewers, construct manholes at same time sewer is being constructed.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify the City Engineer for examination of subgrade to determine if the subgrade has heaved upwards after being excavated. If heaving has not occurred, the subgrade shall be over-excavated to allow for a 24-inch-thick layer of crushed stone wrapped in filter fabric as the foundation material under the manhole base. If there is evidence of heaving, a pile-supported concrete foundation, as detailed on the Drawings, shall be provided under the manhole base.

C. Cast manhole foundations and walls monolithically. A cold joint with approved water stop will be allowed when the manhole flow line depth exceeds 12 feet. No other joints will be allowed unless shown on Drawings.
3.3 PIPE CONNECTIONS:

A. Install approved resilient connectors at each pipe entering and exiting sanitary sewer manholes in accordance with manufacturer’s instructions.

B. Ensure that no concrete, cement stabilized sand, fill, or other solid material is allowed to enter the space between the pipe and the edge of the wall opening at and around the resilient connector on either the interior or exterior of the manhole. Fill the space with compressible material to ensure the resilient connector will maintain full flexibility where evidence of reduced flexibility is encountered.

C. Where a new manhole is to be constructed on an existing sewer, a rigid joint pipe may be used. Install a water stop gasket around the existing pipe at the center of the cast-in-place wall. Join ends of split water stop material at the pipe spring line using an adhesive recommended and supplied by the water stop manufacturer.

D. Do not construct joints on sanitary sewer pipe within wall sections of manholes. Use approved connection material.

E. Construct pipe stubs with resilient connectors for future connections at locations and with material indicated on Drawings. Install approved stub plugs at interior of manhole.

F. Test connection for watertight seal before backfilling.

G. Connect line pipe grouted in place with mortar.

H. Seal internal PVC liner at pipe penetrations using manufacturer’s recommended methods.

3.4 INVERTS FOR SANITARY SEWERS:

A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 per foot maximum.
2. Depth of bench to invert:
   a. Pipes smaller than 15 inches: one-half of the largest pipe diameter.
   b. Pipes 15 to 24 inches: three-fourths of the largest pipe diameter.
   c. Pipes larger than 24 inches: equal to the largest pipe diameter.

3. Invert slope through manhole: 0.10-foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with Class A concrete if not integral with manhole base. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.5 DROP CONNECTIONS FOR SANITARY SEWERS:
A. Construct drop connections with same materials used in main pipe unless otherwise indicated on Drawings. Install a drop connection when a sewer line enters a manhole higher than 30 inches above the invert of the manhole.

B. Encase drop assembly with Class A concrete to form a solid mass. Extend concrete outside of bells a minimum of 4 inches. Cast base of encasement monolithically with manhole base and ensure concrete bonds to exterior manhole wall.

C. Terminate encasement of blind drops a minimum of 5 inches below top of bell and not less than 12 inches above top of next lower bell. Install approved plug at bell.

3.6 MANHOLE FRAME AND ADJUSTMENT RINGS:

A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover matches the pavement surface. Seal between adjustment ring and the precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply a latex-based bonding agent to precast concrete surfaces to be joined with non-shrink grout. Set the cast iron frame on the adjustment ring in a bed of approved sealant. The sealant bed shall consist of two beads of sealant, each bead having minimum dimensions of ½-inch and ¾-inch wide.

B. For manholes in unpaved areas, top of frame shall be set a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. Encase the manhole frame in mortar or non-shrink grout placed flush with the face of the manhole ring and the top edge of the frame. Provide a rounded corner around the perimeter.

C. When indicated on the Drawings, install manhole chimney seals to prevent inflow between manhole frames and chimneys.

3.7 BACKFILL:

A. After leakage testing, place and compact backfill materials in the area of excavation surrounding manholes in accordance with requirements of Section 31233 – Trenching and Backfilling. Use embedment zone backfill material for the adjacent utilities, as shown in City of Houston Standard Details over each pipe connected to the manhole. Provide trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to the manhole, backfill under the existing sewer up to the spring line of the pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade.

3.8 PROTECTION:

A. Protect manholes from damage until subsequent work has been accepted. Repair or replace damaged elements of manholes at no additional cost to the Owner.
END OF SECTION 330561
SECTION 331416 - SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes

1. Specifications identify requirements for both small-diameter water piping and large-diameter water piping. When specifications for large-diameter water piping differ from those for small-diameter water piping, large-diameter specifications will govern for large-diameter pipe.

B. Related Sections

1. Backfill – Section 312323.13
2. Trenching and Backfilling – Section 312333
3. Disinfection Water Utility Piping Systems – Section 330110.58

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the Bid Form.

1.3 REFERENCES:

C. ASTM B 21 - Specification for Naval Brass Rod, Bar, and Shapes.
D. ASTM B 98 - Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
F. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

1.4 SUBMITTALS:

A. Conform to submittal requirements of applicable Section for type of pipe used.

B. Photographs: Prior to commencement of construction, take 35mm color photographs of entire route of project and present one copy of prints and negatives to the Engineer. Required items in photographs include, but are not limited to, the following:

1. Date fixed on negative by calendared attachment in camera (automatically includes date on film).
2. Location of photograph, house numbers and streets, direction of view, along with project numbers on chalkboard in photo.
3. Condition of:
a. Road  
b. Curb.  
c. Particular features (light, shrubs, fences, trees, etc.).  
d. Street failures.

4. Take a sufficient number of photographs to show existence or nonexistence of cracked concrete, trees, shrubs, and grass required by Paragraph 1.03.B. Bind photographs in 3-ring notebook within plastic pockets. No payment will be made for photography under this Section. Include cost in unit price for water pipes.

5. Job number on chalkboard.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS:

A. Install pipe materials which conform to following:
   1. Section 33 11 20.20 - PVC Pipe.  
   2. Section 33 11 20.21 - Fusible PVC Pipe.

B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.

C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.

D. Maximum allowable lead content of 0.25 percent per Section 1417 of the Safe Drinking Water Act.

E. The use of pipes and pipe fittings that contain more than 0.25% lead or solders and flux that contain more than 0.2% lead is prohibited in accordance with 30 TAC §290.44(b)(1).

2.2 WELDED JOINT PROTECTION FITTING:

A. Cylindrical Corrosion Barrier manufactured by Heat-Pro Systems, Inc., or approved equal.

B. O-rings: Conform to National Sanitary Foundation requirements.

2.3 RESTRAINED JOINTS:

A. Ductile-Iron Pipe:
   2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.  
   3. TR-Flex or Field-Lok Joint by U.S. Pipe and Foundry Company.

B. PVC Pipe:
   1. Fittings: JCM 610 Sur-Grip Fitting Restrainer by JCM Industries, Inc. or Series 500 Fitting Restrainer by Ebba Iron, Inc., or approved equal.  
   2. Bell and Spigot: JCM 620 or 621 Sur-Grip Bell Joint Restrainer by JCM Industries, Inc. or Series 1500 or Series 1100HV Joint Restrainer by Ebba Iron, Inc., or approved equal.
C.  Pre-stressed Concrete Cylinder Pipe and Steel Pipe: Welded joints (see Paragraph 3.1 G).

2.4  COUPLINGS AND APPURTEYNANCES FOR LARGE-DIAMETER WATER MAIN:

A.  Flexible (Dresser-type) Couplings:

1.  Install where shown on Drawings or where allowed by the Engineer for Contractor's convenience.  Use galvanized flexible couplings when installed on galvanized pipe, which are cement lined, or when underground.  Provide gaskets manufactured from Neoprene or Buna-N.

2.  For steel pipe: sleeve-type flexible couplings, Dresser Style 38, Rockwell Type 411, or equal.  Thickness of middle ring equal to or greater than thickness of pipe wall.

3.  Flanged adapter couplings for steel pipe: Dresser Style 128, Rockwell Type 913, or approved equal.

4.  Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground.  Coat entire coupling with 20-mil of T.C. Mastic as manufactured by the Tape Coat Company, Inc., Bitumastic No. 50 as manufacturer by Koppers Company, Inc., or approved equal.

B.  Victaulic Joints: Make joint with Victaulic Style 77 coupling fitted with Grade H molded synthetic rubber gasket.

C.  Flap Valves: Provide on discharge of manhole drain line as shown on Drawings.


2.  Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.

3.  Resilient Seat: Buna-N.


6.  Provide Rodney Hunt Series FV-AC, or equal.

PART 3 - EXECUTION

3.1  PREPARATION:

A.  Conform to applicable installation specifications for types of pipe used.

B.  Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished.  Provide watertight pipe and pipe joints.  Lay pipe with bell ends facing in direction of laying.

C.  Lay pipes to lines and grades shown on Drawings.  Use adequate surveying methods and equipment; employ personnel competent in use of this equipment.  Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet.  Measure and record “as-built” horizontal alignment and vertical grade at maximum of every 50 feet on record drawings.

D.  Confirm that separation from gravity sanitary sewers and manholes or from force mains have minimum clearance as specified in this Section or 9 feet in all directions unless a special design is provided on the Drawings:

1.  Parallel water line and gravity sanitary sewer, force main or manhole with no leaks: Minimum 4-foot horizontal clearance from outside wall of water line to outside wall of gravity sanitary sewer, force main, or manhole.
2. Water line crossing above a gravity sanitary sewer or force main with no leaks:
   Minimum 2-foot vertical clearance.

E. Where above clearances cannot be attained, and a special design has not been provided on Drawings, obtain direction from the Engineer before proceeding with construction.

F. Inform the Engineer if any unmetered sprinkler or fire line connection exists which is not shown on Drawings. Make transfer only after approval by the Engineer.

G. Keep pipe trenches free of water, which might impair pipe-laying operations. Prevent pipe bells from coming in contact with subgrade. Grade pipe trenches to provide uniform support along bottom of pipe. Excavate for bell holes for proper sealing of pipe joints after bottom has been graded and in advance of placing pipe. Lay not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and relay as new pipe.

H. Owner will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.

I. If asbestos-cement pipe is encountered, follow safety practices outlined in the Asbestos-Cement Pipe Producers Association publication, Recommended Work Practices for A/C Pipe. Strictly adhere to recommended practices contained in this publication.

J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with a unique designation on the inside of the pipe. Minimum letter height is 4 inches.

K. Laying Large-diameter Water Main:
   1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
   2. Dig trench proper width as shown. When Contractor's operations cause trench width below top of pipe to become 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by the Engineer. No additional payment will be made for higher class of pipe or improved bedding.
   3. Prevent damage to coating when placing backfill. Backfill material shall be free of large rocks or stones, or other material which could damage coatings.
   4. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation. Groove pipe to manufacturer's specifications.

L. Contractor is responsible for assuring the chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for all costs due to downtime if requirements are not met.

3.2 HANDLING, CLEANING AND INSPECTION:

A. Handling:
   1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
   2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not
permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.

3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.

4. For large-diameter water pipes, handle pipe only by means of a sling of canvas, leather, nylon, or similar material. The sling shall be a minimum 36 inches in width. Do not tear or wrinkle tape layers.

5. Use precautions to prevent injury to pipe, protective linings and coatings:
   a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
   b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
   c. Do not lift pipe using hooks at each end of pipe.
   d. Do not place debris, tools, clothing, or other materials on pipe.

6. Repair damage to pipe or protective lining and coating before final acceptance.

7. Permit no visible cracks longer than 6 inches, measured within 15 degrees of a line parallel to pipe longitudinal axis in the cores of finished pipe with the following exceptions:
   a. In the surface laitance of centrifugally cast concrete.
   b. In sections of pipe with steel reinforcing collars or wrappers.
   c. Within 12 inches of pipe ends.

8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.

B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation and keep interior clean until the Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.

C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.3 EARTHWORK:

A. Conform to applicable provisions of Section 312316.13 - Excavation, Trenching and Backfilling for Utilities.

B. Bedding: Use bedding materials in conformance with Section 310620.16 - Utility Backfill Materials.

C. Backfill: Use bank run sand or earth or native soil as specified in Section 310620.16 - Utility Backfill Materials. Backfill excavated areas in the same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.

D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Field density tests may be made at a frequency determined by the Engineer. Water tamping is not allowed.
E. Pipe Zone: Including 6-inch pipe bedding and backfill to 12-inches above top of pipe.

3.4 PIPE CUTTING:

A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by the Engineer. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.5 PIPING INSTALLATION:

A. Do not lay pipe unless subgrade is free of water. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material. Wedging or blocking up bell will not be acceptable.

B. Do not install pipe at greater depth than its design allows.

C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day’s work.

3.6 JOINTS AND JOINTING:

A. Rubber Gasketed Bell-and-Spigot Joints (Concrete Cylinder Pipe, PVC, Steel, and DIP):

1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
4. After the pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary, before remaking joint.
5. Where preventing movement of 16-inch-diameter or greater pipe is necessary due to thrust, use restrained joints.

B. Flanged Joints (Concrete Cylinder Pipe, DIP, Steel):

1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south centerline. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at the factory to proper dimensions.
3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
4. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrile seal, Type E Line Backer gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal conforming to ANSI 21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrile seal, Type E Line Backer gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal conforming to ANSI 21.11 mechanical joint gaskets.
C. Welded Joints with Protection Fittings:

1. In addition to welding requirements in Paragraph 3.6B, conform to protection fitting manufacturer’s installation recommendations.
2. Provide services of a technical representative of the manufacturer available on site at the beginning of pipe laying operations. Representative shall train welders and advise Contractor and Engineer regarding installation and general construction methods.

D. Welded Joints (Concrete Cylinder Pipe, Steel):

1. Prior to starting work, provide certification of qualification for welders employed on the project for type of work procedures and positions involved.
2. Joints: AWWA C 206. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
3. Furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
4. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1-1/2-inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.
5. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true and preserve alignment during welding operation. For butt-welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16-inch offset. Use line-up clamps for this purpose; however, care shall be taken to avoid damage to linings and coatings.
6. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat-resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
7. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
8. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
9. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.
10. Do not weld under any weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
11. Make tack weld of same material and by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
12. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
13. Welded Joints for Large-diameter Water Pipes:
   a. Furnish pipe with trimmed spigots and interior welds for 36-inch and larger pipe.
   b. Use exterior welds for 30-inch and smaller.
c. Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2-1/2 degrees.
d. Employ an independent certified testing laboratory, approved by the Engineer, to perform weld acceptance tests on welded joints. Include cost of such testing in contract unit price bid for water line. Furnish copies of all test reports to the Engineer for review. Test by magnetic particle test method for lap welds or by X-ray methods for butt welds, for 100 percent of all joint welds. The Engineer has final decision as to suitability of all welds tested.

E. Harnessed Joints (Large Diameter Water Pipes - Concrete Cylinder Pipe):

1. Use of snap-ring type restrained joints on pipe is limited to 16-inch through 48-inch diameters.
2. Position snap-ring joint bolt on top (12 o'clock portion). Provide a minimum 1/2-inch joint recess. Use joint "diapers" a minimum of 12 inches wide.
3. For field adjustments with deflections beyond manufacturer's recommendations:
   a. Field trim spigot.
   b. Do not engage ring.
4. Harnessed joints are not permitted in areas defined on Drawings as potentially petroleum contaminated material, in tunnels, or at any bend greater than 5 degrees.

F. Joint Grout (Concrete Cylinder Pipe, Steel):

1. Mix grout by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Use grout within 20 minutes after mixing. Discard grout that has set. Re-tempering of grout by any means is not permitted.
2. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without re-tempering. Use grout for filling grooves of such consistency that it will adhere to ends of pipe.
3. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
4. Follow established procedures for hot and cold weather concrete placement.
5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.
6. Grouting exterior joint space: Use minimum 9-inch-wide Ethafoam "diaper" or wrapper placed around pipe and over joint. Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of the joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with a structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
7. Interior Joints for Pipe Smaller than 24 Inches: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use a swab approved by the Engineer for 20-inch pipe and smaller.

8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if the joint bands are protected by zinc metallizing or other approved protective coatings.

9. Remove and replace improperly cured or otherwise defective grout.

10. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply flexible sealer, such as Flex Protex by Gifford-Hill America, or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer’s recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.

11. Interior Joints for Large-diameter Water Pipes:
   a. Pipe 30 inches and 24 inches: Circumferentially butter bell with grout using hand trowel as described in Paragraph 3.6E.7.
   b. Pipe 36 inches and larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe. Accomplish grouting at end of each workday. Obtain written acceptance from the Engineer of inside joints before proceeding with next day’s pipe laying operation.

G. Joint Testing:
   1. In addition to testing individual joints with feeler gauge approximately 1/2-inch wide and 0.015-inch thick, use any other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. These tests shall be made at no additional cost to the Owner.
   2. Test 100 percent of welded joints including any joint or seam welded after successful hydrostatic testing by methods as described in Paragraph 3.6C, Welded Joints. The Owner reserves right to require additional tests if tests performed indicate an unacceptable weld. Repair rejected weld.

H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by the Engineer. Contractor may submit details of other methods of providing curves and bends for consideration by the Engineer, and if accepted, shall be installed at no additional cost to the Owner.
   1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
   2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
   3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
   4. Replace, repair, or reapply coatings and linings as required.
   5. Assessment of deflection may be measured by the Engineer at any location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
   6. When rubber gasketed pipe is laid on a curve, join pipe in a straight alignment and then deflect to curved alignment.

I. Closures and Field Modifications to Steel, Concrete Cylinder Pipe, and Fittings: These requirements also apply to standard pipe joints, which exceed manufacturer’s recommended deflection.
1. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.

2. Fill exposed interior and exterior surfaces with non-shrink grout.

3. For large-diameter water pipes, perform field welds on interior and exterior of pipe.

4. For large-diameter water pipes, provide minimum overlap of 2 inches of butt strap over adjacent piece on butt-strap closures.

3.7 CATHODIC PROTECTION APPURTEANCES:

A. Where identified on Drawings modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water main, access manhole piping and other major openings in water main, or as shown on Drawings.

B. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint. No additional bonding required where joints are welded for thrust restraint.

C. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

3.8 SECURING, SUPPORTING AND ANCHORING:

A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.

B. Where shown on Drawings, anchor pipe fittings and bends installed on water main by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differ from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

A. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.9 THRUST RESTRAINT:

A. For new water lines 16 inches in diameter and larger, restrain joints as specified in Paragraph 3.6 A.5 of this Section.

B. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in Paragraph 3.6 A.5 of this Section.

C. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.

D. For waterlines less than 4" in diameter, place 2500 psi concrete for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.
E. For waterlines 4-inches in diameter and larger, restrain joints with Megalugs.

F. Passive resistance of soil will not be permitted in calculation of thrust restraint.

G. Use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide welded restraint joints for a minimum length of 16 feet on each side of beveled joints.

3.10 POLYETHYLENE WRAP:
A. Double wrap pipe and appurtenances (except fire hydrants) with 8-mil polyethylene film.

3.11 CLEANUP AND RESTORATION:
A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during chlorination, testing, service transfers, abandonment of old mains, backfill and surface restoration.

B. Upon completion of section not exceeding 4000 feet per crew, chlorinate and pressure test. Begin transfer of services no later than 7 calendar days after successful completion of chlorination and pressure testing.

C. After transfer of services, but no later than 21 calendar days after successful completion of chlorination and pressure testing, begin abandonment of old mains, including resodding and placement of sidewalks and pavements.

D. Do not begin construction of additional sections if above conditions are not met.

E. For large-diameter water pipes, do not install more than 2,000 feet of main, without the previous 2,000 feet being cleaned up and site fully restored. Schedule paving crews so re-paving work will not lag behind pipe laying work by more than 1,000 feet. Failure to comply with this requirement will result in a "Notice of Nonconformance".

3.12 CLEANING PIPING SYSTEMS:
A. Remove construction debris or foreign material and thoroughly clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning.

3.13 DISINFECTION OF WATER LINES: (refer to section 330110.58)

END OF SECTION 331416
SECTION 333111.12 - DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes

1. Ductile iron pipe and fittings for water lines, wastewater force mains, gravity
sanitary sewers, and storm sewers.

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this section. Contractor will
include all costs of the requirements of this section in appropriate bid item(s) on Bid
Form.

1.3 REFERENCES:

A. ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe
and Fittings, for Water.

through 48-in.

C. ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron
Pressure Pipe and Fittings.

or Gray-Iron Threaded Flanges.

E. ANSI A21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior


G. ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast, for
Water and Other Liquids.

H. ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches
through 24 inches and 54 inches through 64 inches for Water Service.


J. ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion
Materials for Wire and Cable.

K. ASTM F 477 - Elastomeric Seals (gaskets) for Joining Plastic Pipe.


M. AWWA C 105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

N. AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type,
for Water and other Liquids.
O. AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

P. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.


R. American Association of State Highway Transportation Officials (AASHTO).

1.4 SUBMITTALS:

A. For pipes 24 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:
   1. Manufacturer’s pipe design calculations.
   2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan and profile view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Engineer.
   3. Calculations and limits of thrust restraint.
   4. Class and length of joint.

B. Submit manufacturer’s certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.

C. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.

D. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE

A. Ductile Iron Pipe Barrels: ANSI A 21.15, ANSI A 21.50 or ANSI A 21.51; bear mark of Underwriters' Laboratories approval; minimum thickness Class 51 for water lines and thickness Class 52 for sanitary sewers, or as shown on Drawings. Provide minimum thickness Class 53 for flanged pipe, and minimum thickness Class 52 for areas with pipe offset sections. Maximum allowable lead content of 0.25 percent per section 1417 of the Safe Drinking Water Act.

B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.

C. For use of pressure class pipe for water lines, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREMA E-80 loads and depths of bury as indicated on Drawings. Design pipes with Marston’s earth loads for a transition width trench for zero to 16 feet of cover. Use Marston’s earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston’s equations for a trench.
condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:

1. Working pressure = 100 psi.
2. Hydrostatic field test pressure = 150 psi.
3. Maximum pressure due to surge = 150 psi.
4. Minimum Pressure due to surge = -5 psi.
5. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.
6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.
7. Unit weight of fill = 120 pcf.
8. Deflection lag factor (Di) = 1.2.
9. Bedding constant (K) = 0.1.
10. Moment coefficient = 0.16.
11. Fully saturated soil conditions hw=h=depth of cover above top of pipe.

**D.** Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.

**E.** Pipe Manufacturer for large diameter water lines: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

<table>
<thead>
<tr>
<th>Line Diameter</th>
<th>Required Bends*</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 and 24 inches</td>
<td>Four 45° bends per 5,000 LF of water line</td>
</tr>
<tr>
<td>&gt; 24 inches</td>
<td>Four 22.5° bends per 10,000 LF of water line</td>
</tr>
</tbody>
</table>

*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer’s option (i.e. two 22.5° bends are equivalent to one 45° bend) and will be counted as one fitting.

**F.** Manufacturer or supplier must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Engineer where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.

**G.** Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Engineer.

**H.** Clearly mark pipe section to show location and thickness/pressure class color coded.

### JOINTS:

**A.** Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.

**B.** Where restrained joints for buried service are required by Drawings, provide one of the following, or equal:

2. Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
3. TR-Flex or Field Lok by U.S. Pipe and Foundry Company.
4. One Bolt by One Bolt, Inc. (4 to 12 inches)
5. Sur-Grip by JCM Industries. (4 to 12 inches)

C. Threaded or grooved-type joints that reduce pipe wall thickness below minimum required are not acceptable.

D. Provide for restrained joints designed to meet test pressures required under Section 330505.31 - Hydrostatic Testing or Section 333123 - Sanitary Sewerage Force Main Piping, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.

E. Bond rubber gasketed joints to provide electrical continuity along entire pipeline, except where insulating flanges are required by Drawings.

F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Engineer. When other methods are deemed satisfactory, install at no additional cost to Owner.

2.3 GASKETS:
A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

2.4 FITTINGS
A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.


C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants, pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.

E. Ductile Iron Compact Fittings for Water lines: ANSI A 21.53; 4-inch through 12-inch diameter fusion bonded epoxy-lined or cement mortar lining.

2.5 COATINGS AND LININGS:
A. For Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A 21.16 fusion bonded epoxy coating interior; comply with NSF 61.

B. Sanitary Sewer and Force Main Interiors:
1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
2. Liner thickness: Nominal 40 mils, minimum 35 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.

4. Acceptable Lining Materials:
   a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
   b. Ceramic Epoxy – Tnemec 431 or Protecto 401 or approved equal.
   c. D1 Fitting supplier shall notify Engineer 48 hours prior to application of internal coatings for D1 fittings. Engineer will inspect supplier’s premises to ensure supplier meets or exceeds minimum standards for surface preparation and proper application of specified internal linings. Engineer will review supplier’s procedures for surface preparation and lining application.
   d. No materials will be accepted without above inspection and procedure review.

C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.

D. Exterior:
   1. Encasement and coatings requirement for water lines
      a. Open cut construction method:
         1) Provide double wrap polyethylene encasement applied in accordance with AWWA C105 or 2) Provide polyurethane coating.
      b. Auger or casing construction method:
         1) Provide minimum thickness Class 52 pipe, double wrap with Polyethylene encasement. Place circumferential wraps of tape or plastic tie straps at two-foot intervals along the barrel of the pipe, and thoroughly seal each end of the polyethylene tube.
      c. Tunnel, casing, or direct bury conform to requirements of paragraph 2.5.E.


E. Polyethylene Wrap: For buried water lines not cathodically protected and sanitary sewers, including point repairs, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of Polyethylene Wrap.

F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, provide bolts made of Type 304 stainless steel.

G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report.
PART 3 - EXECUTION

3.1 INSTALLATION:

A. Conform to installation requirements of Sections 331416 – Site Water Utility Distribution Piping, 333116 – Site Sanitary Sewerage Gravity Piping, and 333123 – Sanitary Sewerage Force Main Piping except as modified in this Section.

B. Install in accordance with AWWA C 600 and manufacturer’s recommendations.

C. Install all ductile iron pipe in polyethylene wrap, unless cathodic protection is provided. Do not use polyethylene wrap with a cathodic protection system.

D. Holiday Testing.
   1. Polyurethane: Conform to requirements.
   2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

3.2 FIELD REPAIR OF COATINGS:

A. Polyurethane: Conform to requirements.

B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION – 333111.12
SECTION 333116 - SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes

1. Site Sanitary Sewerage Gravity Piping and appurtenances, including stacks and service connections.

B. Related Sections

1. Backfill - Section 312323.13
2. Trenching and Backfilling - Section 312333
3. Concrete Manholes – Section 330561

1.2 MEASUREMENT AND PAYMENT:

A. Unit Prices.

1. No separate payment will be made for work required under this Section. Contractor will include all costs of the requirements of this Section in the appropriate bid item(s) on the Bid Form.

2. Payment for television inspection of existing gravity sanitary sewer will be on a linear foot basis. Measurement will be taken along centerline of pipe from centerline to centerline of manholes.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS:

A. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

B. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Videos become property of the Owner.

1.4 QUALITY ASSURANCE:

A. Qualifications: Install a sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.

B. Regulatory Requirements:

1. Install sewer lines to meet the minimum separation distance from any potable water line, as scheduled below. The separation distance is defined as the
distance between the outside of the water pipe and the outside of the sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.

2. Make notification to the Engineer if water lines are uncovered during sanitary sewer installation where the minimum separation distance cannot be maintained.

3. Lay gravity sewer lines in straight alignment and grade.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Inspect pipe and fittings upon arrival of materials at the job site.

B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along the ground. Do not roll pipe unrestrained from delivery trucks.

C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around the outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with the interior surface of the pipe to lift or move lined pipe.

PART 2 - PRODUCTS

2.1 PIPE:

A. Provide piping materials for Site Sanitary Sewerage Gravity Piping of the sizes and types indicated on the Drawings or as specified.

B. Unlined reinforced concrete pipe is not acceptable.

C. Pipe shall be color coded green.

2.2 PIPE MATERIAL SCHEDULE:

A. Unless otherwise shown on the Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 330531.13 – Pressure Polyvinyl Chloride Pipe.
2. Section 330531.19 – Fusible Polyvinyl Chloride Pipe.

B. Where shown on the Drawings, provide pipe meeting the minimum class, dimension ratio, or other criteria indicated.

C. Pipe materials other than those listed above shall not be used for Site Sanitary Sewerage Gravity Piping.

2.3 APPURTENANCES:

A. Roof, street or other type of surface water drains shall not be connected or reconnected into the sanitary sewer lines.
2.4 BEDDING AND BACKFILL MATERIAL:

A. Bedding and Backfill: Conform to requirements of Section 312333 – Trenching and Backfilling and Section 312323.13 - Backfill.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Provide barricades, flashing warning lights, and warning signs for excavations. Maintain barricades and warning lights where work is in progress or where traffic is affected by work.

B. Perform work in accordance with OSHA standards. Employ trench safety system as specified in Section 314133 - Trench Excavation Safety System for excavations over 5 feet deep.

C. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Project Manager and agency or utility company for repairs or relocations, either temporary or permanent.

D. Install and operate dewatering and surface water control measures in accordance with Section 312319 – Dewatering.

E. Do not allow sand, debris or runoff to enter sewer system.

3.2 DIVERSION PUMPING:

A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from the Engineer.

B. Design piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.

C. No sewage shall be diverted into any area outside of the sanitary sewer.

D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Project Manager so that required reporting can be made to Texas Natural Resources Conservation Commission and Environmental Protection Agency by Project Manager.

3.3 EXCAVATION:

A. Earthwork: Conform to requirements of Section 312333 – Trenching and Backfilling. Use bedding as indicated on Drawings.

B. Line and Grade: Establish the required uniform line and grade in the trench from benchmarks identified by the Engineer. Maintain this control for a minimum of 100 feet behind and ahead of the pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of the work. Use of appropriately sized grade boards,
which are substantially supported, is also acceptable. Protect the boards and location stakes from damage or dislocation.

C. Trench Excavation: Excavate pipe trenches to depths shown on Drawings and as specified in Section 312333 – Trenching and Backfilling.

3.4 PIPE INSTALLATION BY OPEN CUT:

A. Install pipe in accordance with the pipe manufacturer’s recommendations and as specified in the following paragraphs.

B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Project Manager.

C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench, so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.

E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.

F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.

G. Provide lubricant, place and drive home newly laid sections with come-a-long winches to eliminate damage to sections. Install pipe to "home" mark where provided. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Project Manager.

H. Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

J. Where a gravity sanitary sewer is to be installed under an existing water line with a separation distance of at least 2 feet and less than 9 feet, install the new sewer pipe so that one full joint length of pipe is centered on the water line crossing. Embed the sewer pipe in cement stabilized sand for a minimum distance of 9 feet on each side of the crossing.

K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 1-foot separation distance.

L. Where the length of stubs is not indicated, install a 4-foot length and seal the free end with an approved plug.
3.5 PIPE INSTALLATION OTHER THAN OPEN CUT:

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

3.6 INSTALLATION OF APPURtenances:

A. Construct manholes to conform to requirements of Section 330561 - Concrete Manholes, as applicable.

3.7 INSPECTION AND TESTING:

A. Mandrel Testing: Use a Mandrel Test to test flexible pipe for deflection.

B. Pipe Leakage Test. After backfilling a line segment and prior to tie-in of service connections, visually inspect Site Sanitary Sewerage Gravity Piping where feasible, and test for leakage.

3.8 BACKFILL AND SITE CLEANUP:

A. Backfill and compact soil in accordance with Section 312333 – Trenching and Backfilling.

B. Backfill trench in specified lifts only after pipe installation is approved by Project Manager.

C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks.

D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil.

3.9 POST-INSTALLATION TELEVISION INSPECTION:

A. Prior to final acceptance of newly constructed Site Sanitary Sewerage Gravity Piping, perform cleaning and closed-circuit television inspection.

B. Upon completion of video review, Contractor will be notified regarding final acceptance of sewer segment.

END OF SECTION 333116
SECTION 333123 - SANITARY SEWERAGE FORCE MAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Sanitary Sewerage Force Main Piping.

B. Related Section

1. Trenching and Backfilling - Section 312333

1.2 MEASUREMENT AND PAYMENT:

A. Unit Prices.

1. Payment for installation of force main pipe by open cut, augered with or without casing, or within limits of Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis. Measurement will be taken along center line of pipe from end to end. Payment will be made for each foot of force main installed, complete in place including pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes, acceptance testing, and pipe and accessories.

2. Payment for installation of force main pipe at a bayou crossing is on a lump sum basis.

3. The Unit Price item identifies line segments between stations as shown on Drawings.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCE STANDARDS:

A. ACI 318 - ACI Building Code and Commentary.


D. ASTM D 2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.


F. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).
1.4 SUBMITTALS:

A. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

B. Force mains 24 inches in diameter and larger: Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

C. Submit qualifications, proposed methods, equipment, materials, and sequence for acceptance testing of the pipeline. Submit evidence of experience with pipeline proving by pigging for at least three projects of equal or greater scope; project list shall include dates, size and length of pipe, location, owner name, contact person, and telephone number. Provide certificate of training by the manufacturer of the pigging equipment being used.

D. Submit test reports as specified in Part 3 of this Section.

PART 2 - PRODUCTS

2.1 PIPE FITTING MATERIAL SCHEDULE:

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 330531.13 – Polyvinyl Chloride Pressure Pipe.
2. Section 330531.19 – Fusible Polyvinyl Chloride Pipe.

B. Pipe shall be color coded green.

2.2 THRUST RESTRAINT:

A. Unless otherwise shown on Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete. Place concrete in accordance with details on Drawings. Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below pipe or fitting to 12 inches above.

B. For force mains larger than 12 inches in diameter, and where indicated on Drawings, provide restrained joints conforming to requirements of force main pipe material specifications. Install restrained joints for length of pipe on both sides of each bend or fitting for full length shown on Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Provide thrust restraint at tees, plugs, blow off drains, valves, and caps, as indicated.

E. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to following design requirements:

1. Design calculations shall be performed and sealed by Professional Engineer licensed in State of Texas.
2. Base design calculations upon soil parameters quantified in geotechnical report for site where alternative thrust restraint system is to be installed. When data is not available for site, use parameters recommended by geotechnical engineer.
3. The design system pressure shall be specified test pressure.
4. The following safety factors shall be used in sizing restraint system:
   a. Apply factor of safety equal to 1.5 for passive soil resistance.
   b. Apply factor of safety equal to 2.0 for soil friction.

5. Contain encasement entirely within standard trench width and terminate on both ends at pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads, including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION BY OPEN-CUT:

   A. Perform excavation, bedding, and backfill in accordance with Section 332333 – Trenching and Backfilling.

   B. Wrap ductile-iron pipe and fittings with polyethylene. Polyethylene wrap shall not be installed on ductile iron pipe protected by a cathodic protection system.

   C. Install pipe in accordance with the pipe manufacturer’s recommendations and as specified in the following paragraphs.

   D. Install pipe only after excavation is completed, the bottom of the trench is fine graded, bedding material is installed, and the trench has been approved by the Engineer.

   E. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench, so the interior surfaces of the pipe follow the grades and alignment indicated. Provide bell holes where necessary.

   F. Install pipe with the spigot ends toward the direction of flow. Form a concentric joint with each section of adjoining pipe to prevent offsets.

   G. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed. Remove foreign material and debris from the pipe.

   H. Provide lubricant, place and drive home newly laid sections with come-a-long winches to eliminate damage to sections. Install pipe to “home” mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Project Manager.

   I. Keep excavations free of water during construction and until final inspection.

   J. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

   K. Where sanitary sewer force main is to be installed under an existing water line with a separation distance of less than 2 feet, install one full joint length of pipe centered on the water line and maintain a minimum 6-inch separation distance.
3.2 PIPE INSTALLATION OTHER THAN OPEN-CUT:

A. For installation of pipe by auguring, jacking, or tunneling, conform to requirements of specification section of auguring or tunneling work.

3.3 HYDROSTATIC TESTING:

A. After the pipe and appurtenance have been installed, test line and drain. Prevent damage to the Work or adjacent areas. Use clean water to perform tests.

B. Project Manager may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in the presence of the Project Manager.

D. Test pipe at 150 psig or 1.5 times design pressure of the pipe, whichever is greater. Design pressure of the force main shall be the rated total dynamic head of the lift station pump.

E. Test pipe at required pressure for minimum of 4 hours.

F. Maximum allowable leakage shall be as calculated by following formula:

\[ L = \frac{(S)(D)(P^{0.5})}{155,400} \]

Where:

- \( L \) = Leakage in gallons per hour per 1,000 feet of pipe.
- \( S \) = Length of pipe in feet.
- \( D \) = Inside diameter of pipe in inches.
- \( P \) = Test pressure in pounds per square inch.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by Project Manager.

H. Plug openings in the force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering the tested pipeline.

3.4 PIGGING TEST:

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of an open-cell polyurethane foam body, without any coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of the nominal cross-sectional area of the pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to the force main being tested.

C. Test Execution: Pigging test shall be conducted in the presence of the Engineer. Provide at least 48-hours’ notice of scheduled pigging of the force main prior to commencing the test.
END OF SECTION 333123
SECTION 333216 - PACKAGED WASTEWATER GRINDER PUMP ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Packaged grinder submersible sewage pumps complete and operational with TOP pre-engineered fiberglass pump station, valve vault, motors, and accessories as shown in the plans and specified.

2. Coordination:

   a. Review installation procedures under other Sections and coordinate with the Work related to this Section.
   
   b. Coordinate pumps and motors with electrical work as specified in the Electrical Specification.

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

1.3 REFERENCES:

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. American National Standards Institute (ANSI)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
5. Institute of Electrical and Electronic Engineers (IEEE)
7. National Electrical Manufacturers Association (NEMA)
8. Steel Structures Painting Council (SSPC)

1.4 PERFORMANCE REQUIREMENTS:

A. Furnish and install the submersible, non-clog grinder wastewater pumps capable of handling raw unscreened sewage in accordance with these Specifications and as shown on the Drawings.

B. The Fiberglass pump station shall have an integral, hopper-shaped pump station bottom, which is self-cleaning. The flat surface area shall be minimized to an area that is directly influenced by the pump suction and shall be free of obstacles. The bottom surface area shall have a ratio of 1:4 as it relates to the cross-sectional area of the pump station. The sloping walls of the pump station bottom shall further optimize the self-cleaning features of this station by directing all solids, trash, and sludge normally found in sewage and
wastewater, to the suction of the submersible pumps to facilitate removal and effectively clean the bottom.

C. Number of pumps, minimum and maximum operating capacities, TDH, and other pump design data are tabulated on the Drawings.

D. Pumps shall be designed for continuous operation without cavitation within the specified operating range. The pump shall have a minimum hydraulic efficiency of 30 percent at the rated capacity. The NPSHR at the maximum operating capacity shall not exceed 30 feet.

E. The pre-engineered pump station shall have a valve vault that is separate from the pump station vessel. The valve vault shall be fabricated in a manner identical to the pump station. The valve vault shall be equipped with an integral drain and check valve to facilitate drainage from the valve vault back into the pump station.

1.5 SUBMITTALS:

A. Submit a list of not less than 5 installations where pumping equipment of the type and approximate size specified has been in successful operation for at least 5 years.

B. Submit locations of the nearest permanent service headquarters of the pump and motor manufacturer for the size of pump and motor submitted.

C. Submit descriptive literature, including a cross-sectional view of each pump and motor combination, which indicates materials of construction, weights, principal dimensions and other important details. Submit dimensioned, to-scale drawings showing placement of pumps, base ells, rail, rail mountings, and access frame and cover. Submit Shop Drawings for access frame and cover.

D. Submit certified characteristic curves showing the head-capacity relationship, brake horsepower, NPSH requirements, pump efficiency (ratio of the water horsepower to brake horsepower) and pump speed. The curves shall be complete for the entire range of operation from shutoff to minimum head conditions. Where pumps are to be used in VFD service, submit curves showing performance at 100% of rated speed and at decreasing speeds that would be expected. Label curves in terms of rpm and Hz. Indicate the minimum rpm, Hz, and gpm for the pump under the conditions shown on the drawings. Submit manufacturer's calculation of radial and thrust bearing L-10 life at the design head and flow indicated on the Drawings.

E. If the proposed pumping equipment is supplied with electrical equipment and components of larger capacity than specified or shown on the Contract Drawings, the shop drawings for the equipment listed in the following Sections shall be submitted in the same package as the shop drawings submitted for this Section.

F. Manufacturer's Certifications:

1. Submit manufacturer's certification that he has carefully examined the Contract Documents in detail, including the arrangement and conditions of proposed electrical, mechanical, and water level settings and structural systems affecting the performance of the pumping equipment units, and the detailed requirements of manufacturing and subsequent installation of the pumping equipment units.

2. Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that
affects the pumping unit, as shown on the Drawings, which have not already been clarified in writing.

3. Submit manufacturer’s certification that the running amperes of the motor will not exceed the nameplate rating of the motor under all expected operating conditions. Submit motor manufacturer’s maximum allowed KVAR.

4. Submit manufacturer’s certification that spare parts, seals, bearings, o-rings and power cable shall be available locally for models to be supplied.

5. Submit manufacturer’s certification that motors are explosion proof and labeled so, approved by Underwriters Laboratories (UL) or Factory Mutual (FM).

G. Factory Tests: Submit 3 copies of certified test reports to the Engineer for review.

1. The pump manufacturer shall perform the following inspections and tests on each pump before shipment:
   a. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
   b. A motor and cable insulation test for moisture content or insulation defects shall be made.
   c. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
   d. Each pump shall be run submerged in water.
   e. After running pump submerged in water, retest motor and cable insulation.

2. If tests do not meet performance specifications, Contractor shall correct deficiencies to provide the specified performance.

3. A written report stating the foregoing steps have been done must be supplied with each pump at the time of shipment. This report must be approved by the Engineer prior to payment.

H. Maximum Allowable Distance Data: Where pumps will be in VFD service (remotely located), submit maximum allowable installation distance data for motor.

1.6 QUALITY ASSURANCE:

A. All materials used shall be new, of high grade, and with properties best suited to the work required.

B. Manufacturer’s Qualifications:

1. Pumping equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Manufacturer shall satisfy the Engineer that it is capable of the following:
   a. Providing local (within 50 miles of the limits of the City of Houston) factory trained personnel to service the pumps and allied equipment when needed within a 48-hour period.
   b. Providing all needed spare parts for the pumps within a 48-hour period.

3. Provide a written manufacturer’s certification that spare parts, seals, bearings, o-rings and power cable shall be available locally for models to be supplied.

C. Coordination Responsibility:
1. In order to ensure equipment compatibility, one manufacturer shall be responsible for providing all submersible wastewater pumping equipment, including pump and motor, access frame and guides.

2. The Contractor shall name a pump manufacturer, who will have responsibility for the function of the complete system in accordance with the intent of these Specifications. The named manufacturer shall be experienced in similar work.

3. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

D. Substitution: The engineering design is based on a certain manufacturer's equipment. If the Contractor's choice of equipment is approved but requires modifications to plant, equipment or piping for installation, the Contractor is responsible for submitting revised engineering design and drawings to make the proposed equipment compatible with the project, at no additional cost to the Owner.

1.7 DELIVERY, STORAGE AND HANDLING:

A. Deliver equipment to site, and store and protect off the ground in enclosed shelter.

B. The pump cable end shall be sealed with a high-quality protective covering to make it impervious to moisture or water seepage from submersion or other causes prior to electrical installation.

1.8 EVALUATION AND SELECTION:

A. The Owner reserves the right to select any equipment, which is deemed to be in its best interest.

1.9 WARRANTY:

A. Pump manufacturer shall furnish to the Owner a warranty written expressly from the manufacturer to the Owner, covering workmanship and material for 5 years or 10,000 hours of operation under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of Final Acceptance.

B. Acceptance. Warranty shall be in printed form and previously published as the manufacturer's Standard Warranty for all similar units manufactured. Pumps repaired under warranty will be returned to the job site freight pre-paid.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Through shop drawing submittals, the following named manufacturers will be considered, provided the submitted equipment meets the specified requirements and system operating conditions:

1. Flygt (CP Models only)
2. KSB
3. Approved Equal (Minimum 14 days prior to bid opening)

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to Contract Specifications.
2.2 PRE-ENGINEERED FIBERGLASS PUMP STATION CONSTRUCTION:

A. The station cylinder shall be wound to the station bottom so that it the assembly is a monolithic design capable of withstanding the full hydrostatic head from the exterior of the station while the station is completely empty.

B. The cylinder shall be made of FRP using the filament winding process. A safety factor of two (2) on the minimum ultimate tensile strength of the laminate bottom shall be used in designing the basin and cylinder wall thicknesses for the station, taking into account all the normally imposed loads arising from flotation, soil pressures, normal backfill, handling loads, operating loads, and static loads imposed by equipment used in hoisting the pumps in and out of the station.

C. The cylinder is a filament wound laminate constructed of saturated continuous strand glass roving in a controlled pattern over a corrosion resistant white-pigmented resin layer that is to be 8 mils thick, minimum. Roving shall be uniform through entire length of cylinder as required to provide adequate thickness for mechanical loads of application. The winding pattern shall be combination of helical and hoop wraps and shall produce a dense laminate without non-reinforced resin pockets or air bridging between rovings. The glass content of structural laminate shall be 60% to 70% by weight.

D. The station bottom shall be 30% to 50% glass content, chop spray laminate, constructed by built up layers of chop spray and chopped strand mat applied along the catalyzed resin.

E. All inside surfaces shall be smooth and free of cracks and crazing. The inside surface will be pigmented or gel coated to a bright white finish. All surface other than those made in contact with mold surface shall be coated with air-inhibited resin or gel coat, this includes any edges of laminate.

F. The station shall have an anti-flotation flange located near the bottom of the station. The flotation flange is integral part of the station.

2.3 PUMP CONSTRUCTION:

A. Casing:

1. Major pump components shall be of fine-grained gray cast iron, ASTM A48, Class 35B or better, with smooth surfaces devoid of blow holes and other irregularities and shall be double shrouded non-clogging design. Surfaces coming into contact with sewage, other than stainless steel shall be protected by an approved sewage resistant coating.

2. Mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber o-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical o-rings, grease or other devices shall be used.

3. Pump suction flange shall be drilled to ANSI standard, class 125.

B. Power Cable:

1. The cable entry water seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall be sealed by an
elastomer grommet, epoxy potting material, or a combination of both. The cable entry sealing system shall provide strain relief for the terminal connections and allow access to the terminal connections without adversely affecting the integrity or function of the seal system.

2. Cables shall be oil, grease and abrasion resistant, and meet applicable standards. The outer jacket shall be polyurethane or other material equally suitable for immersion in wastewater.

3. Cables shall be capable of operating on either 230-volt or 460-volt, 3 phase service and under continuous submergence without loss of watertight integrity to a depth of 65 feet.

4. No parallel power cables are acceptable unless they are size #1/0 or larger.

5. Motors 7.5 HP and over shall have reconnectable terminal blocks. All leads shall be numbered.

C. Submersible Motor:

1. The pump motor shall be a NEMA Design B squirrel-cage, induction, shell type design, housed in an oil-filled or air-filled watertight chamber. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155 degrees C (311 degrees F). The use of bolts, pins or other fastening devices requiring penetration of the stator housing shall be rejected. The rotor bars and short circuit rings shall be of aluminum. The motor shall be designed for continuous duty, capable of sustaining a minimum of 15 starts per hour, evenly spaced. The pump/motor shall be capable of operating at liquid temperature of 104 degrees F per FM requirements without overheating or operating in the service factor. Motor shall be non-overloading over the entire range of the operating curve within the nameplate HP. A performance chart shall be provided showing curves for torque, current, a minimum service factor of 1.15, input/output kw and efficiency.

2. The motor shall be UL listed or FM approved as explosion-proof, suitable for NEC Class I, Division 1, Group C and D environments.

3. Each unit shall be provided with an adequately designed cooling system totally self-contained with no external mechanical devices. Pumps shall be designed to operate continuously with the fluid level at the top of the pump volute.

4. Maximum motor speed shall be 1200 rpm for pumps with discharge diameter greater than or equal to 6-inches.

5. For sizes 20 HP and smaller, the motor shall be equipped with dual voltage connections for 230/460 volts.

6. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with 3 thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with and supplemental to external motor overload protection and wired to the control panel.

7. For motor sizes larger than 100 HP, an independent thermal switch shall be included to monitor the lower motor bearing temperature.

8. The pump shall be equipped with moisture sensors in the oil-filled seal chamber to indicate seal leakage. Motors larger than 20 HP shall be equipped with a leakage sensor to detect water in the stator chamber.

9. Motor shall be in VFD service and must conform to NEMA MG1, part 31 for VFD applications requiring higher peak voltage withstand.

D. Shaft: Each pump shaft shall be one piece of AISI type 420 stainless steel, or heat-treated carbon steel C 1035 protected by a stainless-steel shaft sleeve. The shaft shall
be of sufficient diameter to assure rigid support of the impeller and to prevent excessive vibration at all speeds.

E. Pump Seal: Each pump shall be provided with a tandem mechanical shaft seal system. The upper seal of the tandem set of seals shall operate in an oil chamber located just below the stator housing. This set shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon (or better) ring, and functions as an independent secondary barrier between the pumped liquid and the stator housing. The lower seal of the tandem set of seals functions as the primary barrier between the pumped liquid and the oil housing. This set shall consist of a stationary ring and a positively driven rotating ring, both of which shall be silicon carbide or tungsten carbide. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring action between upper and lower seal faces shall not be acceptable.

F. Bearings: Bearings shall be permanently lubricated ball or roller type rated in accordance with AFBMA for an L-10 duty life of at least 80,000 hours at the rated capacity.

G. Impeller:

1. The impeller shall be of fine-grained gray cast iron, Class 30 or better, dynamically or statically balanced, double shrouded non-clogging design having a long throughlet without acute turns. The impeller shall be capable of handling 3-inch minimum diameter solids, fibrous materials, heavy sludge and other matter found in normal sewage application. The impeller hub shall be accurately fitted and mechanically secured to the motor shaft.

2. The volute shall be of a single piece, concentric or non-concentric design, and shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller. The volute bottom shall be of a suction bell design for pumps with 12-inch discharge and larger.

3. A replaceable wear ring shall be installed to provide efficient sealing between the volute and impeller. The wear rings shall consist of AISI Series 300 or better heat-treated stainless steel. For pumps 10 HP and below the pump shall be equipped with brass or nitrite rubber volute wear ring only.

2.4 ACCESSORIES:

A. Access Frames and Covers:

1. The station cover shall be ¼-inch thick Type 5086 aluminum diamond plate with an integral Safe-Hatch access cover.

2. Halliday Products as shown on the Drawings, U.S. Foundry Series AHD or AHS, or Pre-Approved Equal.

3. For watertight service, Halliday Products Series H2W, U.S. Foundry Series THD or THS, or approved equal.

4. Aluminum access frames and covers shall be provided by the pump supplier. Fasteners, hinges and other hardware shall be type 316 stainless steel.

5. The frame shall be extruded aluminum with an integral seat and anchor flange. Door leaves shall be 1/4-inch thick aluminum floor plate reinforced to H-20 live load with 30 percent impact factor per AASHTO specifications.

6. The access door shall be equipped with a flush cast aluminum drop handle which does not protrude above the cover surface and an automatic hold open arm with a red vinyl release grip, that automatically holds the door in a 90 degree open
position utilizing a stainless steel pin at the point where the door meets the hold open arm.

7. Hinges shall be stainless steel with stainless steel tamperproof hardware. Doors shall be equipped with a stainless steel, watertight slamlock with a threaded aluminum plug, removable outside handle and an inside release handle. The slamlock must latch onto a stainless-steel catch bolted to the frame.

8. Doors shall also include a recessed padlock assembly that consists of a cast aluminum enclosure that is sized to restrict access by bolt cutters, a stainless-steel staple for a padlock and a hinged stainless-steel cover which does not protrude above cover surface.

9. Doors shall be equipped with stainless steel spring operators for lift assist and to retard downward motion. All parts of the spring operator shall be stainless steel or aluminum and to ensure visual inspection. Spring operators shall be open type. The spring operators shall be engineered and installed so that in the event of slamlock failure the door will remain closed. The force required to open any one door shall be provided.

10. The access opening shall have a permanently installed fall through protection grate system that provides continuous safety assurance in both its closed and open positions. When closed, the grate shall allow visibility for inspection and performance of limited maintenance below it. When open, the grate shall act as an additional barrier to the access door opening. The system shall be a “Hinged Hatch Safety Grate” as manufactured by U. S. F. Fabrication, Inc. or equal.

11. Apply bituminous paint on all areas that come in contact with concrete.

12. A written 10-year material and/or workmanship warranty on all components shall be provided.

B. Pump Guide System: Pump manufacturer shall provide a guide rail system complying with the following requirements:

1. Type 316 stainless steel rails, replaceable without man entry into the wet well.
2. Lower bracket integral with pump support/discharge fitting.
3. Type 316 stainless steel upper bracket bolted to access cover frame.
4. Intermediate brackets as shown on the Drawings, if required.

C. Bolts, Studs and Nuts:

1. All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, “Screw Threads”, Coarse Thread Series, unless otherwise specified.
2. Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, “Wrench-Head Bolts and Nuts and Wrench Openings”, Heavy Series, unless otherwise specified. All nuts shall be hexagonal in shape.
3. Anchor bolts, flange bolts, studs and nuts shall be Type 316 stainless steel in conformity with ASTM A276.

2.5 PUMP PROTECTION SYSTEM:

A. Manufacturer shall furnish a complete pump monitoring and protection system consisting of an intrinsically safe solid state monitoring system to be installed in the motor starter cubicle, and independent probes integral to the pump/motor wired to a sealed cable entry terminal box for connection of submersible control cables.

B. Monitoring unit shall be solid state, intrinsically safe system designed for mounting within the motor starter cubicle. Monitoring system shall accept inputs from the sensors.
specified and shall output independent contacts which close to alarm each condition, or separate independent output terminals suitable for direct connection to interposing relays for alarm contact development. Provide a separate N.C. alarm contact, rated at 120V, 5A inductive, which opens on any failure. Monitor system shall be suitable for operation from a 24VAC unregulated, unlimited power supply. Provide any additional equipment or appurtenances required to provide current and voltage limited intrinsically safe installation as specified. The monitoring system shall accept separate isolated N.O. contacts, which close to indicate pump running and to reset after pump trip.

C. Sensors shall be independently wired to the monitoring system. Provisions for the following sensors for each pump:

1. Stator leak (one required).
2. Bearing temperature for pumps over 100 HP. (one required)
3. Stator temperature (one per phase, field test and connect to highest reading obtained)

2.6 SHOP PAINTING:

A. Pump motor size up to 100 HP:

1. Pump Exterior:
   b. Primer: One coat of alkyd resin primer, 1.6 mils minimum.
   c. Finish: Chloric rubber paint, 2.4 mils minimum.

2. Machine Finished Surfaces:
   a. Machined parts are cleaned to remove all dirt and grease.
   b. Cleaning is done so as not to affect primer or deteriorate adherence to finish paint.
   c. Storage and transport is carried out in such a way that rust attack on machined surfaces does not occur.
   d. At assembly, surfaces are coated with a corrosion preventive paint.

B. Pump motor size greater than 100 HP:

1. Pump Exterior:
   a. Pre-treatment: Sandblast cleaning and removal of all oil and dust.
   b. Primer: One coat of alkyd resin primer, 1.6 mils minimum.
   c. Finish coat: Two coats of chloric rubber paint, 2.1 mils each coat.

2. Machine finished surfaces:
   a. Machined parts are cleaned to remove all dirt and grease.
   b. Cleaning is done so as not to affect primer or deteriorate adherence to finish paint.
   c. Storage and transport is carried out in such a way that rust-attack on machined surfaces does not occur.
   d. At assembly, surfaces are coated with a corrosion preventive paint.
PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation of the pumping equipment shall conform to the manufacturer’s instructions and recommendations and reviewed shop drawings.

B. Field Tests:

1. Each pump will be subjected to a 6-hour field operational test before acceptance as follows:

   a. The unit under test shall be properly installed in the wet well, firmly upon its discharge connection after determination of (a) proper service voltage is being supplied and (b) proper rotation of the impeller. No cooling by forced or circulated air shall be allowed.

   b. Capacity Test: On four occasions, wet well shall be filled with liquid to an elevation sufficient to allow each single pump to operate for 3 minutes, independent of the control regime. Time required to pump down known volume shall be measured as evidence of each pump’s capacity. All portions of the force main must have been constructed and tested prior to this test.

   c. Snore Tests: Snore is defined as that state when the pump is alternately pumping liquid and air and usually occurs when the pump pumps the liquid down to expose its inlet. The unit(s) under test shall be submerged with just enough liquid to accomplish “snore” and allowed to run two times for 10 minutes minimum.

C. Start-up Data: Contractor shall complete and submit the start-up records and maintenance data sheets.

END OF SECTION 333216
SECTION 334100 - STORM SEWER SYSTEM

PART 1 - GENERAL

A. Summary: Section includes storm sewer system and appurtenances from a point 5 feet outside building lines to the point of disposal (outfall).

B. Related Work:

1. General: Drawings and general provisions of the contract, including conditions and Division 1 Specification Sections, apply to this section.

2. Section 31 23 00 - Earthwork

C. Submittals: Submit record documents locating actual horizontal and vertical location of installed storm sewer system piping, manholes, area drains, catch basins, cleanouts, and related work in accordance with requirements of Division 1 Contract Closeout.

PART 2 - PRODUCTS

A. Inlet Gratings, Manhole Covers and Frames: ASTM A 48, Class 30B, heavy-duty gray cast iron as produced by Vulcan Foundry, Neenah Foundry Company, McKinnley, or equivalent accepted by Engineer.

B. Cast Iron Soil Pipe: ASTM C 74, bell and spigot type with neoprene rubber gaskets conforming to ASTM C 564, unless otherwise required to connect to existing construction. Furnish service weight class.

C. Polyvinyl Chloride Pipe and Fittings: ASTM D 3034, Type PSM, SDR 35 for sizes 4" to 15"; and ASTM F 679 for sizes 18" to 36". Provide elastomeric gasket joints conforming to ASTM D 3212. Provide lubricant recommended by pipe manufacturer and compatible with gasket material.

D. Precast or Formed-In-Place Manholes and Boxes: Minimum 3000 psi compressive strength with Grade 40 reinforcing steel complying with ASTM A 615.

E. Reinforced Concrete Pipe: ASTM C 76, Class III or IV as required to provide required cover, and with tongue and groove compression gasket joints complying with ASTM C 443.

F. Ductile Iron Gravity Sewer Pipe: ASTM A 746, bell and spigot type with neoprene rubber gaskets conforming to AWWA C 111, within 5’ of building lines unless otherwise required to connect to existing construction.

PART 3 - EXECUTION

A. Install storm sewer system in accordance with requirements of authorities having jurisdiction.

B. Laying Pipe: Lay pipe with full bearing for each pipe section throughout its length, to true grades and alignment and continuous slope in the direction of flow. Provide recesses in
the excavation bottom to receive bells for pipe having bell and spigot ends. Lay pipe with bells facing up the slope with spigot end entered fully into adjacent bell. Seal joint in accordance with local authorities having jurisdiction.

C. Provide bedding and backfill constructed in accordance with Section 31 23 00-Earthwork.

D. Testing Lines: Inspect and test lines before backfilling to assure free flow without displacement or other damage. Remove obstructions, replace damaged components, and re-inspect system until satisfactory. Plug ends of completed pipe and conduct low pressure (4 psig) air test in accordance with ASTM C 924.

END OF SECTION 334100
SECTION 337119 - UNDERGROUND DUCT BANKS

PART 1 – GENERAL

1.1 SECTION INCLUDES
   A. Underground electrical and telephone, data, communcation duct banks.

1.2 REFERENCES
   A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix

1.3 SUBMITTALS
   A. Submit the following under the provisions of Uniform General Conditions & Special Conditions. Catalog cut sheets of the ducts and spacers.

1.4 DELIVERY, STORAGE AND HANDLING
   A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling.
   B. Clearly mark packages or crates stating that the material is for electrical duct banks only.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Thomas and Betts.
   B. Underground Devices Inc.
   C. Walker Division, Butler Manufacturing Company.

2.2 MATERIALS AND EQUIPMENT
   A. Conduit. Construct ducts using schedule 80 rigid PVC conduit. Refer to Section 260533, Conduit, Fittings and Bodies.
   B. Spacers. Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements.
   C. Concrete. Use steel reinforced, red concrete as duct encasement. Refer to Division 3.
PART 3 – EXECUTION

3.1 PREPARATION

A. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities.

B. Verify that materials are on-site in proper condition and that sufficient quantity is on hand for the work.

C. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete.

D. Be prepared for inspection of the duct banks before reinforcing rod is installed.

E. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware.

F. Provide 24-hour notice to Texas Parks and Wildlife Department (TPWD) Construction Manager and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.2 INSTALLATION

A. Use the size and types of conduit as detailed for the various duct banks required for the project.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 4-inch minimum concrete separation between the outer surfaces of the conduits.

D. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 lbs./cu.yd. to concrete used for envelopes for easy identification during subsequent excavation.

E. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.

F. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.

G. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

H. Make bends of 30° or more using rigid galvanized steel.

I. Provide 12-inches of separation between electrical and, telephone, data, communication ducts.

J. Reinforce duct banks throughout.

1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12-inches.
on centers, and No. 5 tie-bars transversely placed at 36-inch maximum longitudinal intervals.

2. Maintain a maximum clearance of 2-inches from bars to the edge of the concrete encasement.

K. Where ducts enter structures such as handholes, manholes, pullboxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.

L. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or contribute to corrosion of ducts or prevent adequate compaction of fill.

M. Install a bare stranded copper duct bank ground in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system.

N. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12-inches long and with a cross-section approximately one-fourth inch less than the inside cross-section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Repull the rag or sponge swab until the swab emerges clean.

O. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

P. Install a warning ribbon approximately 12-inches below finished grade over underground duct banks. Refer to Section 260553, Electrical Identification.

Q. For manholes and pull boxes below grade, install wire racks to support cables properly around the perimeter and keep them dry.

R. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings.

END OF SECTION 337119
SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Valves, gates and accessories for exposed, submerged and other types of piping.

1.2 MEASUREMENT AND PAYMENT:

A. No separate payment will be made for work required under this section. Contractor shall include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

1.3 REFERENCES:

B. AWWA C509 - Resilient Seated Gate Valves.
C. AWWA C508 - Check Valves.
E. ASTM A395 - Ductile Iron Castings.
F. ASTM A48 - Gray Iron Castings.
H. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

1.4 QUALITY ASSURANCE:

A. Manufacturer's Qualifications:

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.
2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

1.5 SUBMITTALS:

A. Shop Drawings: Submit for review, detailed drawings, data and descriptive literature on valves and appurtenances, including:

1. Dimensions.
2. Size.
4. Weight.
5. Protective coating.
6. Actuator weight, where applicable.
7. Calculations for actuator torque, where applicable.
8. Wiring diagram, where applicable.

B. Submit manufacturer’s valve sizing calculations for verification of sizing for air release valves, air and vacuum valves, and surge relief valves.
   1. Manufacturer’s Certifications.

C. Submit manufacturer’s certificates of compliance with ANSI, AWWA and other listed standards.

1.6 OPERATION AND MAINTENANCE DATA:
   A. Submit a detailed operation and maintenance manual for valves and appurtenances provided under this Section.

1.7 DELIVERY, STORAGE AND HANDLING:
   A. Have products delivered, stored and protected. Store valves and appurtenances off the ground in enclosed shelter.

PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS:
   A. Mark and identify valves in conformance with standards, these Specifications or to the manufacturer’s standard.

   B. Bolts, studs and nuts to be Type 316 stainless steel.

   C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

   D. For handwheel operators on valves 4-inches or larger where located more than 5 feet above the operating floor, provide chain and chainwheel or extension operators. Use chainwheels fabricated of malleable cast iron with chain guides. Provide stainless steel chains of a length to extend to within 5 feet of the operating floor.

   E. To exterior surfaces of valves, apply a shop coating in accordance with Section 09 90 10 – Protective Coatings, System 100 or 103, 12MILS DFT.

2.2 CHECK VALVES:
   A. Swing check valves 3-inches through 14-inches having a system pressure 30-psi or less shall be air cushioned with side mount lever and weight. The valve shaft shall extend through both sides of the body with minimum shaft diameters equal to APCO Series 6000. The cushion shall be totally enclosed, swivel mounted at the bottom, and equipped with a micrometer air control valve and air breather filters. Valves shall be APCO Series 6000, PRATT-CCNE Series 8500 (Pneumatic), GA Industries 250-D, or equal.

   B. Swing check valves 10-inches through 14-inches having a system pressure greater than 30 psi shall be oil cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, PRATT-CCNE Series 9000 (Oil Cushioned), or equal.
C. Swing check valves 16-inches and larger regardless of system operating pressure shall be oil cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, PRATT-CCNE Series 9000 (Oil Cushioned), GA Industries 250-DOC, or equal.

D. Check valves of special design utilizing controlled closing of the disc, such as APCO Series 6000B (Bottom-Buffer), GA Industries Fig. #25-DXH, PRATT-CCNE Series 9000 (Decelerator), or equal, shall be used when specifically indicated on the Drawings. These valves are special valves used to control the surge pressure in the force main upon multiple pump shutdown during a power failure. Other surge control check valves utilizing ball or cone valve and power cylinder operator may also be used as approved by the Engineer.

E. All check valves shall have 316 series stainless steel hinge shafts, 316 stainless steel body seats and 316 stainless steel resilient seat retainer rings.

2.3 ECCENTRIC PLUG VALVES:

A. Eccentric plug valves shall be the non-lubricated eccentric type with cast iron bodies, resilient-faced plugs or replaceable resilient seats in the bodies.

B. Operators: All valves for 4-inch and larger service shall have worm gear operators, nickel or stainless-steel seats, and ANSI 125 psi flanged ends. Operators shall clearly indicate valve position. Operators on valves in submerged or buried service shall be lubricated and sealed to prevent entry of dirt and water into the operator.

C. Resilient facing shall be suitable for the intended service.

D. All shaft bearings shall be of stainless steel, furnished with permanently lubricated bearing surfaces.

E. Valves up to and including 20 inches in size shall have an unobstructed port area of no less than 80 percent of the full pipe area, and not less than 70 percent for larger valves.

F. Eccentric plug valves shall be manufactured by Clow, De Zurik, Keystone, Val-Matic, Pratt, Milliken, or Victualic.

2.4 SEWAGE AIR RELEASE AND SEWAGE AIR AND VACUUM VALVES:

A. Air Release and Air and Vacuum Valves: Provide when shown on Drawings.

B. Sewage Air Release Valve Design: Single float, single orifice, float operated with a compound lever mechanism to automatically release accumulated air and gases while the system is pressurized and operating.

C. Sewage Air and Vacuum Valve Design: Two float where the top float shuts off against the seat due to the lifting force of the bottom float as liquid enters the valve body. Once closed and pressurized the air and vacuum valve will not open to release air.

D. Fabricate valve body, cover and baffles of Ductile Iron: Fabricate internal metal parts of stainless steel. Make valve seat of Buna-N nitrile rubber.

E. Fit valve with blow off valves, quick disconnect couplings and minimum 6-feet of hose to permit back flushing after installation with dismantling valve.

F. Provide air release valves equal to Series 400/450 SARV by APCO, Figure 925 by G.A. Industries, or Henry Pratt.
G. Provide air and vacuum valves equal to Series 400 SARV by APCO. Figure 935 as manufactured by GA Industries, Val-Matic, or Henry Pratt.

2.5 SURGE RELIEF VALVES:

A. Surge Relief Valves: Provide when shown on Drawings.

B. Operation: Surge relief valves shall protect piping systems from surges by opening quickly at a set pressure and throttling the flow to maintain line pressure at no more than 5 to 10 percent above the pressure setting indicated. Provide relief pressure adjustment by changing the tension on a spring holding the valve disc on its seat.

C. Valve Closing Control: By oil dashpots. Oil shall be drawn into the dashpot from a reservoir when the valve opens and return through a flow control valve when the relief valve closes.

D. Valve Construction: Fabricate valve bodies of cast iron with 300 series stainless steel seat rings. Provide seats that are renewable and resilient. Fabricate hinge shafts of stainless steel and the oil system of bronze. Unless otherwise indicated make the pressure setting 5 percent above normal line pressure.

E. Provide surge relief valves that are 90-degree elbow body configuration. Acceptable manufacturers include APCO series 3000, GA Industries 625-D, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install valves and specialties in accordance with manufacturer’s written instructions to permit intended performance.

B. Eccentric plug valves shall be installed according to the following:

   1. Position the valves with the stem in the horizontal direction.
   2. In horizontal pipelines, position the vales so that the plug swings upward when opening to permit flushing of solids.
   3. Orient the vales to prevent the valve bodies from filling up with solids when closed; however, orient the valves such that the pressure differential forces the plug against the seat in cases where the pressure differential across a closed valve will exceed 25 psi.

3.2 PAINTING:

A. Paint valves and specialties in accordance with applicable AWWA standards and with Section 099713 – Steel Coatings.

3.3 TESTING:

A. Test valves using a hydrostatic pressure test in accordance with AWWA C-600.

B. Test valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION 400551
SECTION 400561 - GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY:
A. Section Includes
   1. Gate Valves and accessories for exposed, submerged and other types of piping.

1.2 MEASUREMENT AND PAYMENT:
A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

1.3 REFERENCES:
A. ANSI B 16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
B. ASTM A 48 - Gray Iron Castings.
D. ASTM A 194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
E. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
H. AWWA C 550 - Protective Interior Coatings for Valves and Hydrants.

1.4 QUALITY ASSURANCE:
A. Manufacturer’s Qualifications:
   1. Valves and appurtenances provided under this Section shall be the standard products in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.
   2. Insofar as possible valves of the same type shall be the product of one manufacturer.

1.5 SUBMITTALS:
A. Shop Drawings:
   1. Submit for review detail drawings, data and descriptive literature of valves and appurtenance, including:
      a. Dimensional.
      b. Size.
      c. Materials of construction.
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PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS:

A. Mark and identify valves in conformance with referenced standards and these Specifications.

B. Bolts, studs, and nuts shall be Type 304 stainless steel.

C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

2.2 GATE VALVES:

A. Gate Valves shall be solid wedge type, with resilient nitrile rubber (Buna-N) seating surface. Provide valves that comply with AWWA C509. Acceptable manufacturers include American Darling, Clow, Kennedy, Mueller, U.S. Pipe or pre-approved equal.

B. Supply gate valves rated as 200 psi water working pressure with 400 psi hydrostatic test for structural soundness for sizes 2 inches through 12 inches.

C. Stems: Non-Rising type (NRS), 300 series stainless steel or low-zinc bronze conforming to ASTM B 62.

D. Valve Bodies: Cast iron conforming to ASTM A 126 or ASTM A 395. Internal hardware shall be 300 series stainless steel.

E. Coatings: Internal and external surfaces of the valve, except those encapsulated in resilient material, shall be coated with a fusion-bonded epoxy conforming with AWWA C 550.

F. Opening: Valves shall open counterclockwise and so indicated on hand wheel.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install valves and specialties in accordance with manufacturer’s written instructions to permit intended performance.

B. Support and anchor valves in accordance with drawings.
3.2 PAINTING:
   A. Paint valves and specialties in accordance with Specification 099713 – Steel Coatings.

3.3 TESTING:
   A. Test Valves using a hydrostatic pressure test in accordance with AWWA C 600.
   B. Test Valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION 400561
SECTION 400578.19 - AIR RELEASE AND VACUUM RELIEF VALVES

PART 1 - GENERAL

1.1 SUMMARY:
A. Section Includes
   1. Air release and vacuum relief valves.

1.2 MEASUREMENT AND PAYMENT:
A. No separate payment will be made for work required under this section. Contractor will include all costs of the requirements of this section in the appropriate bid item(s) on the bid form.

1.3 REFERENCES:
G. AWWA C512-15 - Air-Release, Air Vacuum, and Combination Air Valves for Water and Wastewater Service

1.4 SUBMITTALS:
A. Submit manufacturer's product data for proposed valves for approval.

PART 2 - PRODUCTS

2.1 DESCRIPTION:
A. Provide air release, air and vacuum valves, vacuum valves, and combination air valves designed to fulfill functions of air release (permit escape of air accumulated in line at high point of elevation while line is under pressure) and vacuum relief.

B. Provide inlet and outlet connections, and orifice as shown on Drawings.

C. Valve exterior: Painted with shop-applied primer suitable for contact with potable water.
2.2 MATERIALS:

A. Air Release Valves: Provide approved air release valves ASTM A 48, Class 30, cast iron; float and leverage mechanism, ASTM A 240 or ASTM A 276 stainless steel; orifice and seat, stainless steel against Buna-N or Viton mechanically retained with hex head nut and bolt. Other valve internals shall be stainless steel or bronze.

B. Air Release and Vacuum Relief Valves: Provide single-body, standard combination valves or duplex-body custom combination valves as indicated on Drawings.

1. For 2 inch and 3 inch, single-body valves, provide inlet and outlet size as shown on Drawings and orifice sized for 100 psi working pressure.
   a. Valve materials: body, cover, and baffle, ASTM A 48, Class 35, or ASTM A 126, Grade B cast iron; plug or poppet, ASTM A 240 stainless steel; float, ASTM A 240 stainless steel; seat, Buna-N; other valve internals, stainless steel.

2. For 3 inch and larger duplex body valves as shown on Drawings, provide approved air release valve.
   a. Air and vacuum valve materials: body and cover, ASTM A 48, Class 35, cast iron; float, ASTM A 240 stainless steel; seat, Type 304, stainless steel and Buna-N; other valve internals, stainless steel or bronze.
   b. Air release valve: Constructed as specified in paragraph above on Air Release Valves.

C. Vacuum Relief Valves: Provide approved air inlet vacuum relief valves with flanged inlet and outlet connections as shown on Drawings. Provide air release valves in combination with inlet and outlet, and orifice as shown on Drawings. Valve shall open under pressure differential not to exceed 0.25 psi.

1. Materials for vacuum relief valves: valve body, ASTM A 48, Class 35, cast iron; seat and plug, ASTM B 584 bronze, copper alloy 836; spring, ASTM A 313, Type 304, stainless steel; bushing, ASTM B 584 bronze, copper alloy 932; retaining screws, ASTM A 276, Type 304, stainless steel.

D. Manholes: As shown on Drawings conforming to requirements of Section 330561 – Concrete Manholes.

PART 3 - EXECUTION

3.1 EARTHWORK:

A. Conform to applicable provisions of Section 312333 – Backfill.

3.2 SETTING VALVES IN MANHOLES AND VAULTS:

A. If required by Engineer, provide services of technical representative of valve manufacturer available on-site during installation of valves.

B. Prior to installing valves, remove foreign matter from within valves. Inspect valves in open and closed position to verify that parts are in satisfactory working condition.
C. Install valves and valve manholes and vaults where indicated on Drawings or as located by Engineer. Set manholes and vaults plumb and as detailed. Center manholes on valves. Compact cement-stabilized sand around each manhole and vault for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Provide above-ground vents for manholes and vaults as indicated on Drawings.

3.3 DISINFECTION AND TESTING:

A. Disinfect valves and appurtenances as required by Section 330110.58 - Disinfection of Water Utility Piping Systems and test as required by Section 330505.31 – Hydrostatic Testing.

3.4 PAINTING OF PIPING AND VALVES:

A. Paint piping and valves located in manholes, stations, and above ground using approved paint.

END OF SECTION – 400578.19