4881 TIMUQUANA ROAD – CLASS III/IV PUMP STATION UPGRADES

TECHNICAL SPECIFICATIONS

BID SET

APRIL 2021

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JEA

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SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

Summary of work, other contracts, work sequence, operation of existing facilities, use of premises, Owner furnished products and coordination.

1.02 SUMMARY OF WORK

A. The work to be performed under this Contact consists of the rehabilitation and repair of the Timuquana Road Class III/IV Pump Station Upgrades project, which generally includes the following:

- Replacement of three (3) existing pumps with new pumps and Variable Frequency Drive (VFD)s units.
- Replace exterior doors and doorframes.
- Replace existing ventilation systems with a new ventilation system.
- Replace existing internal and external lighting systems with new LED lighting systems.
- Replace existing potable water system with a new potable water system.
- Replace all plumbing including plumbing fixtures.
- Replace existing electrical powering system with a new system, including grounding and emergency power system (i.e. generator, ATS, fuel tanks (if needed), etc.).
- Remove existing mechanical bar screen and design a FRP grating/cover system to seal openings.
- Recoat all piping, equipment and structures per JEA Standard Section 411 and AS-502.
- Assess the structural integrity of the existing pump station superstructure. Rehab the superstructure (Motor Room, Screen Room, Generator Room, Pump Room,

Wet Well, Influent Chamber) and all its accessories (i.e. stairways, fall protection, covers, grating, etc.) as required.

- Update all safety related deficiencies. The existing dock shall have a removable handrail system designed.
- Replace existing piping, fittings, valves and apparatus with new piping, fittings, valves and apparatus that complies with JEA's latest standards. Replace all mechanical process components (sluice gates, screens, sump pump and pumps). Confirm existing suction end piping for all pumps are adequate. If not, design the proper suction end piping.
- Design a magnetic meter with bypass on the discharge force main.
- Design a new seal water system.
- Replace existing instrumentation with new instrumentation that complies with JEA's latest standards.
- Design a lift system (crane, hoist, monorail, etc.) for removal of shaft driven flooded suction pumps and motors.
- Design site improvements including landscaping and security coordinated with JEA requirements.

In addition, the following improvements have been added for increased storm resiliency.

- Design of a totally independent, float controlled, diesel engine driven pump sized for the total capacity of the station.
- Design of two automatic transfer switches for the diesel generator to provide full redundancy and Class 1 Reliability.
- Design provisions for future installation of odor control at the pump station. The design will follow existing JEA odor control standards. Power for the odor control equipment will be provided for in the MCC's and conduits will be installed to the proposed equipment location.
- Research temporary watertight flood protection panels for doors to building, brick sealers for exterior, and other options to reduce water intrusion into the building during extreme weather events.
- Expansion of the existing generator room to the north including a new wall at the

existing column that supports the existing overhang. A new door on the south wall of the proposed electrical room. The existing door to the motor room will remain. The existing elevated walkway on the south side of the building will be extended to the east for the AC condenser and will continue by walkway to the new generator.

B. Furnish all materials, equipment, tools, and labor which is reasonably and properly inferable and necessary for the proper completion of the Work, whether specifically indicated in the Contract Documents or not.

C. All fees and permits for the permanent construction, which are required by controlling agencies or authorities, including fees for the review of Contract Documents prior to construction, will be procured by the Owner. Other licenses or permits for construction facilities of a temporary nature which are necessary for the prosecution of the work shall be secured and paid for by the Contractor.

D. Repair, replace, or otherwise settle with the Owner, if damage to property or existing facilities occurs, including damage to pavements, utilities, lawns, structures, etc.

E. Construct the Project under a Lump Sum Price Contract.

F. Contract Time: Contractor shall have no more than 270 calendar days to reach substantial completion including DEP clearance. Upon acceptance of substantial completion by Owner and Engineer, the Contractor shall have 30 days of additional calendar days to reach final completion. Final completion shall be within 300 days of Notice to Proceed.

1.03 WORK UNDER OTHER CONTRACTS – NOT USED

1.04 WORK SEQUENCE AND WORKING HOURS

The Contractor's sequence of work may be of his choosing and shall be coordinated with the Owner and Engineer. Normal working hours for the project shall be an eight (8) hour period between the hours of 8:00 a.m. – 7:00 p.m., Monday through Friday. Should the Contractor request of JEA to approve work periods greater than 8 hours a day, he shall make such requests in writing a minimum of 24 hours prior to such work periods.

The Contractor may be required to perform certain work at select locations along the route of construction at times of the day or night when vehicular traffic and pedestrian

traffic is at diminished levels and at times appropriate to other activities which are occurring in the area of the project. The Contractor shall comply with requirements to alter his schedule of work as requested or required by JEA without change to the contract price or time.

1.05 OPERATION OF EXISTING FACILITIES

The project area will be closed to the public during construction. The Contractor shall coordinate all construction activities with the Owner.

1.06 CONTRACTOR USE OF PREMISES

Confine operations at the site to areas permitted by applicable laws, ordinances, permits, and by the Contract Documents. Do not unreasonably encumber the site with materials or equipment. Do not load structures with weight that will endanger the structure. The Contractor shall assume full responsibility for protection and safekeeping of products stored on the job site.

1.07 OWNER FURNISHED PRODUCTS – NOT USED

1.08 COORDINATION

A. The Contractor shall be fully responsible for the coordination of his work and the work of his employees, subcontractors, and suppliers and to assure compliance with schedules.

B. The coordination requirements of this Section are in addition to the requirements in JEA's Solicitation Documents.

C. It is the Contractor's responsibility to coordinate with all the utilities regarding locates, protection of existing facilities, testing, or relocations.

1.09 DRAWINGS AND PROJECT MANUAL

A. The Work shall be performed in accordance with the Drawings and Specifications prepared by CPH, Inc.

B. In all cases where notes, specifications, sketches, diagrams, details or schedules in the Specifications or in the Drawings, or between the Specifications and the Drawings conflict, the higher cost requirement shall be furnished by the Contractor, unless otherwise directed by Engineer.

C. The Contractor shall verify all dimensions, quantities and details shown on the

Drawings, Supplementary Drawings, Schedules, Specifications or other data received from the Engineer, and shall notify same, in writing, of all errors, omissions, conflicts and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory Work, faulty construction or improper operation resulting therefrom, nor from rectifying such conditions at his own expense.

D. All schedules are given for the convenience of the Engineer and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quantity of materials and equipment included in the Work to be done under this Contract.

E. Intent

1. All work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Drawings or in the Specifications, but involved in carrying out their implied intent, or in the complete and proper execution of the Work, is required and shall be performed by the Contractor as though it were specifically delineated or described.

2. Items of material, equipment, machinery, and the like may be specified on the Drawings and not in the Specifications. Such items shall be provided by the Contractor in accordance with the specification on the Drawings.

3. The apparent silence of the Specifications to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.

4. Order of Precedence: Refer to JEA's Solicitation Documents for this project.

1.10 WEATHER

During inclement weather, all work which might be damaged or rendered inferior by such

weather conditions shall be suspended. The orders and decisions of the Engineer as to suspensions shall be final and binding. During suspension of the Work from any cause, the Work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise; and, if the Engineer will so direct, the rubbish and surplus materials shall be removed. Also, refer to additional requirements in the Solicitation Documents.

1.11 PROTECTION AND RESTORATION

The Contractor shall be responsible for the preservation of all public and private Property, and shall use every means of protection necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer. Also, refer to additional requirements in the Solicitation Documents.

1.12 DELIVERY AND STORAGE

A. General

1. The Contractor shall be responsible for all material, equipment and supplies sold and delivered to the Owner under this Contract until final inspection of the Work and acceptance thereof by the Owner.

2. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage or any kind whatsoever to the material or equipment.

3. All materials which, in the opinion of the Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the Work, and the Contractor shall receive no compensation for the damaged material or its removal.

4. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, the Contractor shall replace same without additional cost to the Owner.

5. Refer to additional requirements in the Solicitation Documents.

B. Delivery – The Contractor shall

1. Deliver materials in ample quantities to insure the most speedy and uninterrupted progress of the Work so as to complete the Work within the allotted time.
2. Coordinate deliveries in order to avoid delay in or impediment of the progress of the Work of any related Contractor.
3. Schedule deliveries to the site not more than one month prior to scheduled installation without written authorization from the Engineer.
4. Arrange deliveries of products in accordance with construction schedules coordinated to avoid conflict with work and conditions at the site.
5. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
6. Immediately on delivery, inspect shipments with the Owner's field representative to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.
7. Provide equipment and personnel to handle products by methods recommended by the manufacturer to prevent soiling or damage to products or packaging.
8. Submit operation and maintenance data to the Engineer for review prior to shipment of equipment.

C. Storage

1. The Contractor shall be responsible for securing a location for on-site storage of all material and equipment necessary for completion of this project.
2. All material delivered to the job site shall be protected from dirt, dust, dampness, water and any other condition detrimental to the life of the material from the date of delivery to the time of installation of the material and acceptance by the Owner.

3. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.

4. When required or recommended by the manufacturer, the Contractor shall furnish a covered, weather protected storage structure providing a clean, dry, non-corrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this project.

5. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions and free from damage or deterioration.

6. The Contractor shall carefully study manufacturer's storage instructions. These instructions shall be carefully followed and a written record of this kept by the Contractor.

7. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding".

8. Mechanical equipment to be used in the Work, if stored for longer than ninety (90) days, shall have the bearings cleaned, flushed and lubricated prior to testing and start-up, at no extra cost to the Owner.

D. Specific Material Storage Requirements

1. Loose Granular Materials: Store in a well-drained area on solid surfaces to prevent mixing with foreign matter.

2. Cement, Sand and Lime: Stored under a roof and off the ground and kept completely dry at all times.

3. Brick, Block and Similar Masonry Products: Handle and store in a manner to reduce breakage, chipping, cracking and spilling to a minimum.

4. All structural, miscellaneous steel, and reinforcing steel: Store off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting.

   Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven days after written notice

to do so has been given, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections form the Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, and engineering and any other costs associated with making the necessary corrections. In any event, equipment and materials not properly stored will not be included in a payment estimate.

1.13 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

A. Comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to all parties involved in the installation, including two copies for the Engineer's use. Maintain one set of complete instructions at the job site during installation and until completion.

B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements. Should job conditions or specified requirements conflict with the manufacturer's instructions, consult with the Engineer for further instructions. Do not proceed with Work without clear instructions.

C. Perform Work in strict accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

D. The Contractor shall have on hand sufficient proper equipment and machinery of ample capacity to facilitate the installation of the Work and to handle all emergencies normally encountered in Work of this character.

E. Equipment shall be installed in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Plans, unless directed otherwise by the Engineer during installation.

F. All equipment shall be correctly aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.

G. The Contractor shall furnish, install and protect all necessary anchor and attachment bolts and all other appurtenances needed for the installation of the devices included

in the equipment specified. Anchor bolts shall be as approved by the Engineer and made of ample size and strength for the purposes intended. The manufacturer shall furnish substantial templates and working drawings for installation.

1.14 CONSTRUCTION FIELD ENGINEERING

A. Registered Land Surveyor: The Contractor shall retain the services of a registered land surveyor licensed in the State of Florida for the following specific services as applicable to the Work:

   a. Identify existing rights-of-ways and property lines along or adjacent to the Work;

   b. Locate existing utilities and structures as may be affected by the Work;

   c. Locate control points prior to starting the Work;

   d. Replace control points or reference points which may be lost or destroyed.

   e. Prepare a certified survey of the actually constructed facilities based on information concurrent with the construction progress.

B. Contractor shall protect control points prior to starting the Work and shall preserve all permanent reference points during construction. The Contractor shall bear the cost of re-establishing project control points, and bear the entire expense of rectifying Work improperly installed due to not maintaining or protecting or to removing, without authorization, such established points, stakes, and marks.

C. Submittals

   a. Certificate signed by a Registered Surveyor certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

   b. Certified drawings showing locations of all structures, piping conduits and other improvements, including electronic files. These drawings are referenced as the Project Record Drawings and shall be included with the Project Record Documents.

   c. Documentation to verify accuracy of field engineering work when requested by the Engineer.

1.15 UTILITIES

A. Utility Construction

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto, whether owned or controlled by governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage or water. Other public or private property which may be affected by the Work shall be deemed included hereunder.

2. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required.

3. The length of open trench will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Owner. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Owner may require special construction procedures. As a minimum, the Contractor shall conform to the following restoration procedures:

   a. Interim Restoration: All excavations shall be backfilled and compacted as specified by the end of each working day.

      All pipe and fittings shall be neatly stored in a location which will cause the least disturbance to the public. All debris shall be removed and properly disposed of by the end of each working day.

   b. Final Restoration: After completing all utility installations, and after testing of the pipe, final restoration shall be performed. In no event shall final restoration begin after substantial completion.

Maintenance of all restored facilities shall be the Contractor's responsibility. This maintenance shall be performed on an on-going basis during the course of construction.

The Contractor's Progress Schedule shall reflect the above restoration requirements.

B. Existing Utilities

1. The locations of all existing underground piping, structures and utilities have been taken from information received from the respective owner. The locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered.

2. The Contractor shall, at all times in performance of the Work, employ approved methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of existing public utility installations and structures; and shall, at all times in the performance of the Work, avoid unnecessary interference with, or interruption of, public utility services; and shall cooperate fully with the owners thereof to that end.

3. Pipelines shall be located substantially as indicated on the Drawings, but the Owner reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. When the location of piping is dimensioned on the Drawings, it shall be installed in that location; when the location of piping is shown on a scaled drawing, without dimensions, the piping shall be installed in the scaled location unless the Owner approves an alternate location for the piping. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required. The Engineer may require detailed pipe laying drawings and schedules for project control.

4. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities which do not interfere with the completed

Work shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his expense as directed by the Owner. Any existing facilities which require operation to facilitate repairs shall be performed only by the owner of the respective utility.

5. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the proximity of excavation, be temporarily stayed and/or shored in position while Work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

C. Notices

1. All governmental utility departments and other owners of public utilities which may be affected by the Work will be informed in writing by the Contractor within two weeks after the execution of the Contract or Contracts covering the Work. Such notice will be sent out in general, and directed to the attention of the governmental utility departments and other owners of public utilities for such installations and structures as may be affected by the Work.

2. The Contractor shall also comply with Florida Statute 553.851 regarding notification of existing gas and oil pipeline company owners. Evidence of such notice shall be furnished to the Owner within two weeks after the execution of the Contract.

3. It shall be the Contractor's responsibility to contact utility companies at least 48 hours in advance of breaking ground in any area or on any unit of the Work so maintenance personnel can locate and protect facilities, if required by the utility company.

4. The Contractor shall, prior to interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the utility owner and make arrangements for the interruption which will be satisfactory to the utility owner.

D. Exploratory Excavations

Exploratory excavations shall be conducted by the Contractor for the purpose of locating underground pipelines or structures in advance of the construction. Test pits shall be excavated in areas of potential conflicts between existing and proposed facilities and at piping connections to existing facilities a minimum of 48 hours or 1000 feet in advance of Work. If there is a potential conflict, the Contractor is to notify the Engineer immediately. Information on the obstruction to be furnished by the Contractor shall include: Location, Elevation, Utility Type, Material and Size. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer.

E. Utility Crossings

It is intended that whatever existing utilities must be crossed, deflection of the pipe within specified limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the Owner this procedure is not feasible, he may direct the use of fittings for a utility crossing or conflict transition as detailed on the Drawings.

F. Relocations

1. Relocations shown on the Drawings – Public utility installations or structures, including but not limited to light poles, signs, fences, piping, conduits and drains that interfere with the positioning of the Work which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as part of the general cost of doing the Work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.

2. Relocation not shown on the Drawings

   a. Where public utility installations or structures are encountered during the course of the Work, and <u>are not</u> indicated on the Drawings or in the Specifications, and when, in the opinion of the Owner, removal, relocation, replacement or rebuilding is necessary to complete the Work under this contract, such Work

shall be accomplished by the utility having jurisdiction, or such Work may be ordered, in writing by the Owner, for the Contractor to accomplish.

b. If such Work is accomplished by the utility having jurisdiction, it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such Work is accomplished by the Contractor, it will be paid for as a Change Order.

3. All existing utility castings, including valve boxes, junction boxes, manholes, hand holes, pull boxes, inlets and similar structures in the areas of construction that are to remain in service and in areas of trench restoration and pavement replacement, shall be adjusted by the Contractor to bring them flush with the surface of the finished Work.

4. All existing utility systems which conflict with the construction of the Work herein which can be temporarily removed and replaced shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the Work may be done by the Contractor.

G. Lines and Grades

1. All Work under this Contract shall be constructed in accordance with the line and grades shown on the Drawings, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

2. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the project control points set by the Owner, and shall be solely responsible for the accuracy thereof.

3. Reclaimed water main shall have a minimum of 36-inches of cover over the top of the pipe. Cover shall vary to provide long uniform gradient or slope to pipe to minimize air pockets.

4. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:

   a. Gravity Lines: continuous control, using laser beam technology.

   b. Pressure Lines: control stakes set at 50 ft intervals using surveyors level instrument.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 14 00

CONSTRUCTION SEQUENCE

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Project consists of work on property owned by JEA. The Timuquana Road Pump Station will remain in service during construction. All coordination shall be in presence of Owner and Engineer and shall be confirmed in writing by Owner in order to be valid.

B. Performed work in a manner to minimize disruption to the operation and staff. Modifications that affect or may affect the operation of the system shall not be made without written permission from Owner.

C. Construction progress schedule required under Section 01 33 00 shall reflect the conditions presented in this section.

D. Special precautions are necessary to ensure that no damage occurs to the facilities that are to remain in operation and are not to be modified or replaced. Any temporary facilities, materials, equipment, and labor required to ensure that no damage occurs shall be provided by Contractor as part of the Work and at no additional cost to Owner.

E. Owner reserves the right to postpone connections to existing utilities due to operational and/or weather related concerns.

1.02 NOTIFICATION REQUIREMENTS

A. Contractor shall give a minimum of 5 working days advance written notice to Owner and Engineer of each component proposed for shutdown, tie-in, or disruption, all of which shall be subject to OWNER's approval and limitations. Shutdowns, tie-ins, or disruptions specifically mentioned in the Section must conform to this requirement and any others requested by Owner or Engineer.

1.03 SUBMITTAL REQUIREMENTS

A. Contractor shall submit shop drawings and working drawings in accordance with

Section 01 33 00 to show schedules and details of all temporary services, bypasses, shutdowns, tie-ins and connections to existing systems.

1.04 SITE CONDITIONS

A. Contractor shall coordinate the activities to allow for orderly and timely completion of all the work.

B. When access through construction areas must be disrupted, Contractor shall provide alternate acceptable access for the station operators.

C. Contractor shall coordinate activities in the common areas with pump station operators. Contractor shall submit to Owner and Engineer a description and schedule as to how the common areas will be used, recognizing the required coordination with the pump station operators. Access to existing process equipment must be provided to the Station Operating Personnel at all times.

D. Various interconnections within the Pump Station may depend on the closure of various valves. Contractor shall coordinate with the Station Operation Personnel prior to attempting any such closure and provide any corrective measure of temporary facilities necessary to attain the shut-off or bypass needed to perform the work without interrupting operation.

E. Some interconnections within the station may require temporary partial power shutdown. Contractor shall make every effort necessary to minimize the shutdown time and coordinate with the Station Operating Personnel and/or utility authorities prior to attempting any such power shutdown. Furthermore, Contractor shall provide any corrective measure or temporary facilities necessary to perform the work without interrupting the station operation.

F. During all Start-Up and Performance testing activities, Contractor shall make available manpower, equipment, and manufacturer's representatives required to make any necessary adjustments and training.

G. Dust tight and noise dampening partitions or other methods approved by Engineer to contain dust, debris, rain, noise, etc., from construction areas shall be provided. Protective covers for equipment and furnishings shall be provided by Contractor in areas of work within new buildings and structures.

1.05 CONSTRUCTION CONSTRAINTS

A. Contractor shall meet the constraints below and shall consider these constraints when developing the overall plan of construction. The list is not intended to release Contractor from responsibility to coordinate Work in any manner which will ensure project completion within the time allowed. The following areas are not necessarily listed in their required sequence of construction. A suggested sequence within each area, where necessary, is included. However the overall general sequence outlining the critical items is outlined below. Should Contractor wish to deviate from this overall sequence they shall obtain permission and approval prior to proceeding. Any facility that is required to be in service to operate the station shall either remain in service or be temporarily relocated and reinstalled until the new system is approved and on-line.

1. Initiate work on Chamber 1 and Pump 1
    a. Close slide gates in order to isolate chamber 1 of the wet well.
    b. Close the isolation valves on Pump 1.
    c. Close the suction isolation valve on Pump 2 so that it only pulls suction from chamber 2 of the wet well.
    d. Temporarily block flow to chamber 1 from the dividing box by constructing a temporary bulk head wall.
    e. Replace slide gates at chamber 1.
    f. Clean and coat all interior channel walls of chamber 1.
    g. Remove and replace Pump 1 and all associated suction/discharge piping and valves.
    h. For very short duration (<8 hr) – close one isolation valve to Pump 2 so that valve can be replaced.
    i. Fill wet well chamber 1 by opening all gates. Leak test slide gates, pressure test new piping and valves, test pump.
2. Initiate work on Chamber 2 and Pump 3
    a. Close existing slide gates in order to isolate chamber 2 of the wetwell.
    b. Close the isolation valves on Pump 3.
    c. Close the suction isolation valve on Pump 2 so that it only has suction from chamber 1 of the wet well.
    d. Temporarily block flow to chamber 2 from the dividing box by

constructing a temporary bulk head wall.

e. Replace slide gates.
f. Clean and coat all interior channel walls of chamber 2.
g. Remove and replace Pump 3 and all associated suction/discharge piping and valves.
h. For very short duration (<8 hr) – close second isolation valve to Pump 2 so that valve can be replaced.
i. Fill wet well chamber 2 by opening all gates. Leak test slide gates, pressure test new piping and valves, test pump.

3. Step 3 – Pump 2 Replacement
   a. Close isolation valves to Pump 2.
   b. Replace pump 2, check valve, and all piping/fittings.
   c. Close isolation valve on head pipe during low flow period for a short duration (<4 hr) and replace isolation valve.
   d. Pressure test new piping and valves, test pump. Additional sequencing for coating the dividing box may be necessary.

B. Sitework

1. Since work will be occurring around active existing pipes and structures, the Contractor shall prepare working drawings of existing and proposed new work to scale and submitted to the Engineer in advance of excavation. This will require additional pot-holing and excavations to locate and determine pipe elevations. The Engineer has provided all known existing information as a starting point to the Contractor.

2. All site and underground pipe and structures installation work shall be organized and scheduled to accomplish the following:
   a. Owner access to facilities shall be maintained at all times.
   b. All underground work shall be performed concurrently to avoid subsequent trenching through the same areas to a reasonable extent.
   c. Yard electrical work and piping work shall be shown on the same working drawings and fully coordinated horizontally and vertically.
   d. Existing systems shall remain fully operational except for pre-planned,

scheduled, and organized temporary outages.

3. New slabs or pavement shall not be installed until all piping, cables, conduits, and duct banks under the paved area have been installed. Roads shall be stabilized with crushed stone until that time. Any weak areas in base course or existing pavement shall be removed and replaced prior to the final surface course installation.

4. All connections to existing facilities shall be scheduled through Owner and Engineer to minimize the impact on station operations and construction progress.

C. Electrical

1. There shall be no demolition work or shutdowns of the electrical system without approval by the Engineer and Owner. The Contractor shall plan in advance for modifications required. Contractor shall coordinate the location of any new conduits and hand dig areas to avoid other utilities in the area. Detailed locations of new underground electrical shall be coordinated by the Contractor and included in the Contractor's yard piping working drawings which also show other existing utilities, conduits, ductbanks and yard structures.

D. Final Piping Connections and Pressure Testing

1. Final connections will be required to existing pipes on the site. All connections shall be coordinated with the station operating staff and scheduled a minimum of five days in advance with Owner. Contractor shall pressure test all piping prior to making connections. Contractor shall coordinate with the Owner to complete all bacteriological testing on all new facilities.

2. Once the new Pump Station is ready for operation, the Contractor shall make all connections to the existing distribution system. The Contractor shall schedule connections at least 5 working days prior with the Engineer and Owner. All connections to the existing system will remain in-tact until the system is performance tested and approved for final use.

E. Electrical and High Service Pump Building Testing

1. Submit a plan for testing operation of the building including all HVAC, pumps, VFDs, MCC, and all controls.

2. Test the pumps with water from the new GSR and certify that that the pumps met the operating conditions outlined in Section 43 21 10.

3. After the connections are made, operate the system in automatic mode for five consecutive days without any interruption and conduct performance testing.

F. Testing

1. All facilities and systems shall be tested as a condition precedent to substantial completion. See Section 01 78 25 and equipment specifications for additional requirements. Start-up plans for the facility and equipment shall be submitted, reviewed, and approved by the Engineer.

1.06 PERMITS

A. Arrange for all required inspections and shall close out all City of Jacksonville permits at the end of the Contract.

B. Provide the Engineer the required documentation to close out the FDEP permit.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00

MEASUREMENT AND PAYMENT - LUMP SUM CONTRACTS

PART 1 GENERAL

1.01 SECTION INCLUDES

Measurement and payment provisions and schedule of values

1.02 GENERAL MEASUREMENT AND PAYMENT PROVISIONS

A. Payment for all work done in compliance with the Contract Documents, inclusive of furnishing all manpower, equipment, materials, and performance of all operations relative to construction of this project, will be made as a lump sum which will be complete payment for all work called for or reasonably inferable from the Contract Documents and other work will be considered incidental to the Contract and no additional compensation will be allowed.

B. The Owner reserves the right to alter the Drawings, modify incidental work as may be necessary, and increase or decrease the work to be performed to accord with such changes, including deductions or additions to the scope of work outlined in the Contract Documents. Changes in the work shall not be considered as a waiver of any conditions of the Contract nor invalidate any provisions thereof. Changes resulting in changes in the scope or quantities of Work or time or other conditions of work will be basis for consideration of a Change Order which is to be negotiated and executed before proceeding with the work. A supplemental agreement between the Contractor and the Owner will be required when such changes meet the conditions described in the Supplementary Conditions. Work which has not been authorized by a written Change Order will not be subsequently considered for additional payment.

C. The Contractor shall take no advantage of any apparent error or omission in the Drawings or Specifications, and the Engineer shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

D. If the Contractor makes a claim for an extra or additional cost and requests a Change Order be issued prior to performing the work, and the Engineer and/or

Owner renders a decision denying such request, the Contractor must notify the Engineer in writing within 3 days of the time that the Contractor is informed of the Engineer's decision. Otherwise the Owner will not consider any such difference as a claim for a Change Order or additional payment or time. Any, such written notice received by the Engineer from the Contractor within the 3 day period shall be just reason for the Engineer to re-evaluate his previous decision.

E. Failure on the part of the Contractor to construct any item to plan or authorized dimensions within the specification tolerances shall result in: reconstruction to acceptable tolerances at no additional cost to the Owner; acceptance at no pay; or, acceptance at reduced price, all at the discretion of the Engineer.

F. Work shall not be considered complete until all testing has been satisfactorily completed and the item of work has demonstrated compliance with plans and specifications.

G. A preliminary monthly application for payment shall be submitted to the Owner/Engineer for review five (5) days prior to the submittal for approval of the Contractor's monthly payment request.

1.03 PAYMENT METHOD – SCHEDULE OF VALUES

A. The Company shall submit to JEA a monthly Application for Payment that details the Work completed during that month. The Company shall request payment in accordance with the amounts/percentages set forth on the Schedule of Values that the Company submitted prior to the start of the Work. The Schedule of Values is defined as an itemized list that establishes the value of each part of the Work for a stipulated price and for major lump sum items in a unit price contract. JEA will determine, either by measurement or approximation, the final quantities incorporated into the Work under items for which Unit Prices are established in the Contract Documents. JEA's determination as to the quantity of the Work successfully completed shall be final.

B. Refer to Section 01 37 00 for Schedule of Value requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electronic document submittal service.

B. Number of copies of submittals.

C. Submittal procedures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.

1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
2. It is Contractor's responsibility to submit documents in allowable format.
3. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
4. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Submittal Service: The selected service is:

3.02 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

3.03 SUBMITTAL PROCEDURES

A. General Requirements:

1. Use a separate transmittal for each item.
2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
3. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 DESCRIPTION

Work Specified Herein and Elsewhere

A. Work under this Section includes:

1. Preconstruction meeting.

2. Progress meetings.

1.02 REQUIREMENTS INCLUDED

A. The Engineer shall schedule and administer a preconstruction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work.

1. Prepare agenda for meetings.

2. Make physical arrangements for meetings.

3. Preside at meetings.

B. Representatives of contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. The Contractor shall attend meeting to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.03 PRECONSTRUCTION MEETING

A. The Engineer will schedule a preconstruction meeting prior to beginning the work. This meeting shall be attended by the Engineer, the Contractor, and the Owner. The purpose of the meeting shall be to review shop drawing procedures, construction methods, and to establish a construction schedule.

B. Location: A central site, convenient for all parties designated by the Engineer.

C. Attendance:

1. Owner's Representative.
2. Engineer and his professional consultants.
3. Resident Project Representative.
4. Contractor's Superintendent.
5. Major Subcontractors.
6. Major Suppliers.
7. Utilities.
8. Others as appropriate.

D. Suggested Agenda:

1. Distribution and discussion of:
    a. List of major subcontractors and suppliers.
    b. Projected construction schedules.
2. Critical work sequencing.
3. Major equipment deliveries and priorities.
4. Project Coordination.
5. Designation of responsible personnel.
6. Procedures and processing of:
    a. Field decisions.
    b. Proposal requests.
    c. Submittals.
    d. Change Orders.
    e. Applications for payment.
7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining record documents.
9. Use of Premises:
    a. Office, work and storage areas.

b. Owner's requirements.

10. Construction facilities, controls and construction aids.

11. Temporary utilities.

12. Housekeeping procedures.

13. Check of required Bond and Insurance certifications.

14. Liquidated Damages.

15. Request for a weekly job meeting for all involved.

16. Introduction of the plant superintendent and discussion of the need for continued levels of wastewater treatment through the construction period, accommodations for plant employees, and partial Owner occupancy.

17. Equal Opportunity Requirements.

18. Laboratory testing of material requirements.

19. Inventory of material stored on-site provisions.

20. Posting of Government funding sign.

1.04 PROGRESS MEETINGS

A. Schedule regular periodic meetings. The progress meetings will be held at a frequency determined by JEA.

B. Hold called meetings as required by progress of the work.

C. Location of the meetings: Project field office of Contractor or Engineer.

D. Attendance:

1. Engineer, and his professional consultants, as needed.

2. Subcontractors as appropriate to agenda.

3. Suppliers as appropriate to the agenda.

4. Others as appropriate.

E. Suggested Agenda:

1. Review, approval of minutes of previous meeting.

2. Review of work progress since previous meeting.

3. Field observations, problems, conflicts.

4. Problems which impede construction schedule.

5. Review of off-site fabrication, delivery schedules.

6. Corrective measures and procedures to regain projected schedule.

7. Revisions to construction schedule.

8. Progress, schedule during succeeding work period.

9. Coordination of schedules.

10. Review submittal schedules; expedite as required.

11. Maintenance of quality standards.

12. Pending changes and substitutions.

13. Review proposed changes for:

    a. Effect on construction schedule and on completion date.

    b. Effect on other contracts of the Project.

14. Other business.

15. Construction schedule.

16. Critical/long lead times.

F. The Contractor is to attend progress meetings and is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the work, etc.

G. The Contractor is to provide a current schedule and submittal log at each progress meeting in accordance with Section 01 33 00.

END OF SECTION

SECTION 01 32 34

PRECONSTRUCTION VIDEO

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide all material, equipment, transportation, labor and incidentals to prepare a continuous, color audiovisual recording of the proposed project to serve as a record of pre-construction conditions.

B. All recordings and written records shall become the property of Owner.

C. Recordings shall be submitted in DVD format.

D. Provide video recording no later than 15 days after Notice to Proceed.

1.02 SCHEDULING

A. Make recordings within 30 days prior to commencement of construction. No construction shall begin prior to review by the Owner's Representative of the recording covering the construction area.

B. The Owner's Representative shall have the authority to reject all or any portion of a recording not conforming to specifications and order that it be redone at no additional charge. The Contractor shall reschedule unacceptable coverage within five (5) days after being notified.

1.03 PROFESSIONAL SERVICES

A. Engage the services of a professional known to be skilled and regularly engaged in the business of constructing color, audio-video documentation. The professional shall be prepared to serve as a consultant or witness for the Owner in any litigation, public hearing or other legal or administrative proceeding involving the project.

B. Include the names and addresses of two references that the professional has performed color audio-video recording on projects of a similar nature, including one within the last six (6) months.

C. Furnish to the Owner's Representative a list of all equipment to be used for the recording, i.e., manufacturer's name, model number, specification and other

pertinent information.

1.04 SUBMITTALS

A. Submit videos in accordance with JEA's Solicitation Documents.

B. Qualifications and references of the professional.

PART 2 PRODUCTS

2.01 GENERAL

A. The total recording system and the procedures employed in its use shall be such as to produce a finished product that will be admissible as evidence in a legal or administrative proceeding involving the project. The video portion of the recording shall produce bright, sharp, clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection. The audio portion of the recording shall clearly produce the commentary of the camera operator and be free of distortion.

B. All video recordings shall, by electronic means, display on the screen the time of day, the month, day and year of the recording and the horizontal location of the recording in relation to the project stationing (when applicable). This time and date information must be continuously and simultaneously generated with the actual recording.

PART 3 - EXECUTION

3.01 COVERAGE

A. The recordings shall contain coverage of all surface features within the construction zone of influence. These features shall include, but not be limited to, all roadways, pavement, retention ponds, driveways, sidewalks, culverts, headwalls, retaining walls, landscaping, trees, poles, signs, overhead projections and fences. Of particular concern shall be the existence or non-existence of any faults, fractures or defects. Significant detail of any pre-existing damages to physical features and improvements shall be provided.

B. Panning, zoom-in and zoom-out rates shall be controlled to maintain a clear view of the object. The following features and improvements shall be clear and visible:

a. Cracks in wall.

b. Condition of fencing.

c. Condition of planted areas and type of vegetation.

d. Condition of sodded areas.

e. Conditions of sprinkler systems and associated controls and wiring.

f. Condition of signs.

g. Conditions of lighting and associated wires.

3.02 AUDIO CONTENT

A. Accompanying the video recording of each DVD shall be a corresponding and simultaneously recorded audio recording. This audio recording, exclusively containing the commentary of the camera operator, shall assist in viewer orientation and in the identification, or objective description of the features being shown in the video portion of the recording.

B. The audio recording shall be free from any conversation between the camera operator and any other production technicians that is not pertinent to the project.

3.03 DVD INDEXING

A. DVD shall be permanently labeled and shall be properly identified by number and project title.

B. Each DVD shall have a written log of that DVD's contents. The log shall describe the various segments of coverage contained on that DVD in terms of the names of the streets or easements, coverage beginning and end, directions of coverage, DVD unit counter numbers when possible, and the date of the recording.

3.04 CONDITIONS OF RECORDING

A. All recording shall be performed during times of good visibility. No recording shall be done during periods of significant precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects and to produce sharp, bright recordings of those subjects.

3.05 CONTINUITY OF COVERAGE

A. The recording shall be a single, continuous, unedited recording which begins at one

end of a particular construction area.

B. However, where coverage is required in areas not accessible by conventional wheeled vehicles and smooth transport of the recording system is not possible, such coverage shall consist of an organized interrelated sequence of recordings at various positions along that proposed construction area, i.e., wooded easement area. Such coverage shall be obtained by walking or by a special conveyance.

3.06 COVERAGE RATES

A. The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size and significance of the surface features within that construction areas' zone of influence.

3.07 CAMERA OPERATION

A. When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed 10 feet. The camera shall be mounted such that transport of the camera during the recording process will not cause an unsteady picture.

B. Control camera functional controls, such as camera pan, tilt, zoom-in and zoom-out rates, such that recorded objects shall be clearly viewed during playback. In addition, all other camera and recording system controls, such as lens focus and aperture, video level, pedestal, chroma, white balance and electrical focus shall be controlled or adjusted to maximize picture quality.

C. Maintain viewer orientation of the physical location of the audio and video portions of the recording. To this end, overall views of all visible house and business addresses shall be utilized.

D. In areas where the proposed construction location will not be readily apparent to the video viewer, highly visible yellow flags shall be placed, by the Contractor, in such a fashion as to clearly indicate the proposed center line of construction.

E. The horizontal location of the recording shall be documented by linear measurement, utilizing a "fifth wheel" measuring device, relating the recording to project stationing (when applicable).

3.08 TESTS

A. Submit the completed recordings to the Owner's Representative for review.

B. If any recording or parts of any recording are illegible or inaudible, they shall be re-recorded and edited into the sequence prior to commencement of construction.

END OF SECTION

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SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL REQUIREMENTS

1.01 DESCRIPTION

A. This Section includes but is not limited to requirements for the following:

1. Construction Schedules.
2. Shop Drawings, Product Data, and Samples.
3. Operation and Maintenance Manuals.
4. As-Built/Record Documents.

PART 2 SCHEDULES AND REPORTS

2.01 SCHEDULE OF OPERATIONS

Submit a schedule of operations to the Engineer for approval prior to any construction operations. The construction operations shall be sequenced to provide a minimum of interruption to operation of the existing facilities. Inform the Engineer of any changes in the schedule and allow ample time for the Owner to alter operations as required by the construction of the various components of the work. Approval of traffic control and schedules shall be obtained from the governmental entity having jurisdiction over the area of work.

PART 3 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

3.01 SHOP DRAWINGS

A. Shop Drawings are original drawings, prepared by the Contractor, a subcontractor, or distributor, which illustrate some portion of the work; showing fabrication, layout setting, or erection details.

B. Shop drawings shall be prepared by a qualified detailer and shall be identified by reference to sheet and detail numbers on the Contract Documents.

Reproductions for submittal shall be full size opaque diazo prints or other print acceptable to the Engineer. Reduced size prints will not be reviewed or approved.

3.02 PRODUCT DATA

A. Product data are manufacturer's standard schematic drawings and manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.

B. Standard drawings shall be modified to delete information which is not applicable to the project and supplemented to provide additional information applicable to the project.

C. Catalog sheets, brochures, etc., shall be clearly marked to identify pertinent materials, products, or models.

3.03 SAMPLES

Samples are physical examples to illustrate materials, equipment, or workmanship and to establish standards by which work is to be evaluated.

3.04 CONTRACTOR'S RESPONSIBILITIES

A. Prior to submission, the Contractor shall thoroughly check shop drawings, product data, and samples for completeness and for compliance with the Contract Documents and shall verify all dimensions and field conditions and shall coordinate the shop drawings with the requirements for other related work.

B. The Contractor's responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals.

C. The Contractor shall notify the Engineer, in writing, at the time of submission, of deviations in submittals from the requirements of the Contract Documents and is not relieved by the Engineer's review of submittals, unless the Engineer gives written acceptance of specific deviations.

D. Begin no work which requires submittals until return of submittals with Engineer stamp and initials or signature indicating the submittal has been reviewed.

3.05 SUBMISSION REQUIREMENTS AND ENGINEER REVIEW

A. Submit four (4) prints of each shop drawing plus additional number of copies that contractor requires. Submit at least four (4) copies of product data. Submit the number of samples indicated in the individual Specifications Section.

B. Shop drawings, product data, samples and certifications shall be submitted by the Contractor to the Engineer. Submittals should be properly identified with the name of the project, dated, and each lot submitted shall be accompanied by a letter of transmittal referring to the name of the project and to the specification page number and/or Drawing number for identification of each item. Submittals for each type of work shall be numbered consecutively, and the numbering system shall be retained throughout all revisions.

C. Submittals shall bear the Contractor's stamp of approval certifying that they have been checked. Submittals without the Contractor's initialed or signed certification stamp and submittals which, in the Engineer's opinion, are incomplete, contain numerous errors or have not been properly checked, will be returned unchecked by the Engineer for resubmission. The Contractor shall mark his corrections in Green ink and the Engineer's comments shall be noted in Red.

D. The Contractor shall allow a minimum of 14 days for review of shop drawings. The Engineer will review submittals with reasonable promptness. The Engineer’s review of submittals shall not be construed as a complete check and shall not relieve the Contractor from responsibility for complete compliance with the Contract requirements. No corrections, changes or deviations indicated on submittals reviewed by the Engineer shall be considered as a change order.

E. If submittal is acceptable, the Engineer will return 1 print to the Contractor. If the submittal is not satisfactory, one set of prints will be retained by the Engineer and the remaining prints returned to the Contractor for appropriate action.

F. In the event a third submittal of shop drawings is required, due to previous submittals of incomplete or incorrect shop drawings not in accordance with the Drawings and Specifications, the Contractor will be charged one-half the cost incurred by the Engineer for the review of the third submittal. The Contractor shall bear the total cost incurred by the Engineer for all subsequent reviews. The Engineer costs charged to the Contractor will be at the cost plus rate generally

charged by the Engineer and will be deducted by the Owner from payments due the Contractor.

G. Distribution of copies of acceptable submittals will be as mutually determined by the Contractor, Owner and Engineer on an individual item basis during or following the preconstruction conference.

PART 4 OPERATION AND MAINTENANCE MANUALS

4.01 SUBMITTAL REQUIREMENTS

A. The Contractor shall be responsible for obtaining installation, operation, and maintenance manuals from the manufacturers and suppliers. Submit one (1) electronic pdf copy and four (4) hard copies of manuals (plus additional copies to be returned to the Contractor) to the Engineer within 30 days after approval of shop drawings, product data, and samples, and not later than the date of shipment of each item of equipment to the project site. All operation and maintenance manuals shall be submitted prior to the completion of 35% of the construction.

B. Manuals shall be provided for each piece of equipment including individual components and subsystems of complete assemblies. The section of the manual on operation shall describe the function of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

C. The manual shall contain the following:

1. Table of contents/index
2. Specific description of each system and components
3. Manufacturer's identification, including order number, model, and serial number
4. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
5. Specific on-site operating instructions (including starting and stopping procedures)

6. Safety considerations

7. Project specific operational procedures

8. Project specific maintenance procedures

9. Manufacturer's operating and maintenance instructions – specific to the project

10. Copy of each wiring diagram

11. Copy of Contractor's approved shop drawings

12. List of spare parts and recommended quantities

13. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.

14. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams

15. Provide logical sequence of instructions for each procedure, incorporating Manufacturer's instructions specified.

16. Equipment attributes sheet for submittal of name plate data.

17. Warranties and Bonds.

D. Each manual shall be bound in a binder and labeled to identify the contents, specification section, and project to which it applies.

E. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions by the Contractor to install, test, and start up equipment.

F. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with

engineering data and tests and complete nomenclature and commercial number of replaceable parts.

2. Panelboard circuit directories including electrical service characteristics, controls and communications and color coded wiring diagrams as installed.
3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
4. Maintenance Requirements:
    a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
    b. Alignment, adjusting, balancing and checking instructions
    c. Servicing and lubrication schedule and list of recommended lubricants
    d. Manufacturer's printed operation and maintenance instructions
    e. Sequence of operation by instrumentation and controls manufacturer
    f. Original Manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
5. Control diagrams by controls manufacturer as installed (as-built)
6. Contractor's coordination drawings, with color coded piping diagrams, as installed (as- built)
7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.
8. List of original Manufacturer's spare parts and recommended quantities to be maintained in storage
9. Test and balancing reports, as required

10. Additional Requirements as specified in individual product specification
11. Design data for systems engineered by the Contractor or its Suppliers
12. Equipment attribute Information

    Equipment Attribute Worksheets as presented at the end of this Section shall be provided for all equipment meeting the asset definition as follows:

    Asset Definition

    - Maintenance is recommended
    - Assets have a value greater than $1,000
    - Assets are complete and usable, and perform a distinct function independently (i.e., they pump waste, remove solids, etc.)

    a. This asset definition is intended to give a general indication of which equipment must be included in the Equipment Attribute Worksheets. The Engineer will provide the specific list of equipment that the Contractor must provide information for.

    b. The information requirements are shown in detail in the table. The data requirements include nameplate data, manufacturer and supplier information, information specific to the type of equipment, and recommended preventative maintenance activities.

    c. An electronic copy of the Equipment Attribute Worksheets must be delivered in Excel format and submitted to the Engineer on CD-ROM and submitted with the O&M manuals. It is not necessary to submit printed copies of the Equipment Attribute Worksheets.

G. Manual for Materials and Finishes – In addition to the requirements listed above, for each material or finish, provide the following:

1. Building Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Provide information for re-ordering custom manufactured products.
2. Instructions for Care and Maintenance: Include Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
3. Moisture Protection and Weather Exposed Products: Include product data listing, applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance and repair.

H. Quick Reference Sheets for Equipment

1. For each item of equipment provide the following:
    a. A minimum of one 8 ½ x 11-inch laminated quick reference sheet. Sheets shall be three hole punched and may be double sided.
    b. Each quick reference sheet shall include the following minimum information:
        1) Safety Procedures:
            a. Brief descriptions of each piece of equipment and components
            b. Starting and stopping procedures
            c. Special operating instruction
            d. Routine maintenance procedures
            e. Calibration procedures
            f. Pump curves
            g. Trouble shooting procedures
            h. Name, address, and telephone numbers of local

service representative

c. Provide three copies of quick reference sheets for review by the Engineer.

d. After quick reference sheets have been approved, provide four copies of laminated quick reference sheets to the Engineer in one commercial coiled three-ring binder with durable and cleanable plastic cover.

PART 5 RECORD DOCUMENTS

5.01 GENERAL

A. Provide and maintain on the jobsite one complete set of prints of all drawings which form a part of the contract. Immediately after each portion of the work is installed, indicate all deviations from the original design shown in the drawings either by additional sketches or ink thereon.

B. Maintain the field as-built drawings in as great detail (or better) than that shown in the Construction Drawings (i.e., related fittings where called out, show dimensions as frequently shown on drawings, etc.). Refer to **Table 01 33 00-1** for Contractor's field responsibilities with regard to maintaining records during construction.

C. Contractor shall employ a professional land surveyor licensed in the state of Florida to obtain the As-Built survey data required in **Table 01 33 00-1**.

D. Upon completion of the work, Contractor shall deliver three (3) full-size sets of approved, certified as-builts to the Engineer plus a CD with an electronic file of the as-built drawings in the latest version of AUTOCAD format. Each completed set of "As-Built" drawings shall include on its face, a certified statement by the Contractor's Professional Land Surveyor that the set of "As-Built" drawings accurately depicts the actual work as constructed. The final As-Builts provided by the Contractor to the Engineer shall provide the level of detail as listed in **Table 01 33 00-1** and in 3.05 E and F below.

E. The as-built documents shall also show limits of road restoration, power pole replacement, driveways, new drain lines, new inlets.

F. Mark on the Specifications the manufacturer, trade name, catalog, and supplier of each product actually installed, and mark changes made by change order or field order.

G. At the completion of the Work, deliver the as-built documents to the Engineer, in good condition and free from any extraneous notations.

TABLE 01 33 00 -1: WATER MAIN AS-BUILT INFORMATION

Water System Feature	**Contractor's Field Responsibilites** *(Provide Red Line marks on field set of the approved plans)*	**Contractor's Survey Responsibility by a Licensed Surveyor** *(Survey information to be included in Contractor's ACAD As-Built Drawings)*	**Contractor's ACAD As-Built Drawing Responsibilities** *(Include final ACAD deliverable of As-Built Drawings. Clearly identify on the As-Built Drawings (e.g. clouding) all changes from design drawings, which were marked on the field set of drawings.*
Pipes and Fittings	1) Material, class, size, joint type, fittings. 2) Measure distance between fittings (center of tees, crosses, bends). 3) Depth of pipes during installation at every fitting and appurtenance. 4) Limits of pipe restraint. 5) Location and elevation of pipes at utility crossings.	1) Horizontal and vertical location of main (top of pipe): Measurements/ offset ties shall be referenced to permanent surface improvements at the point of connection, all changes in direction or elevation but not to exceed intervals of 50 feet or less along straight runs and at the pipe terminus. 2) Top and bottom of crossings (drainage, sewer, telephone, cable, TV, electric, etc.) for location and verification of pipe separation requirements.	1) Redraw pipe if location differs from approved plans. 2) Draw existing pipe locations on As-Built Drawings 3) Detail any connection to existing utilities and any horizontal and vertical pipe alignment change.
Valves: Gate Valves (GV); Butterfly Valves (BV); Air Release Valves (ARV); Blow Off Valves (BO)	Type and size	1) Horizontal locations of valve: Valve shall be referenced for future recovery from three permanent surface improvements. 2) Vertical locations of valve: Valve shall be measured to the center of the operating nut.	1) Redraw on drawings if location differs from approved plan. 3) Indicate new information on plans.

EQUIPMENT ATTRIBUTE SHEETS

In order to facilitate the creation of asset records and their corresponding preventive maintenance schedules and activities in the Computerized Maintenance Management System (CMMS), information should be completed using the Excel template provided. Examples are provided in the Equipment Attribute Sheets template to help convey how the information should be completed. In addition, each worksheet in the Excel template is described below. The Engineer will provide the Contractor a copy of the Excel spreadsheet for use in distributing to vendors/manufacturers for completion. The spreadsheet will be pre-populated with the list of assets for which information is required and the specific attributes that need to be completed.

VENDOR-MANUFACTURER WORKSHEET

Information for the equipment Vendors and Manufacturers should be provided on the Vendor-Manufacturer worksheet. The information that is required is listed below.

Vendor ID / Manufacturer ID	A unique identifier for the Vendor or Manufacturer. If this is unknown enter an abbreviation for the Vendor / Manufacturer name.
Vendor/Manufacturer Name	The name of the Vendor or Manufacturer
Address	Company address
City	
State or Country	
ZIP Code	
Phone	Company phone number
Fax	Company fax number
Contact Name	Best contact person
Contact Phone	Contact information associated with the person identified in the Contact Name field
Contact Fax	
Contact email	

LOCAL REPRESENTATIVE WORKSHEET

Information for the local representative should be provided on the Local Representative worksheet. The information that is required is listed below.

Company Name	The company name of the Local Representative
Address	Company address
City	
State	
ZIP Code	
Contact Name	Best contact person
Contact Phone	Contact information associated with the person identified in the Contact Name field
Contact Fax	
Contact email	

ASSETS WORKSHEET

The following Asset information should be provided for all equipment. The equipment that should be included will be pre-populated.

Asset ID	Will be pre-populated
Asset Description	Will be pre-populated
Tag Number	Identifier from the P&ID
Model Number	Equipment Model Number
Serial Number	Serial Number that is specific to the piece of equipment
Vendor ID	Identifier for the Vendor associated with the piece of equipment. The Vendor ID should be defined on the Vendor-Manufacturer worksheet.
Manufacturer ID	Identifier for the Manufacturer associated with the piece of equipment. The Manufacturer ID should be defined on the Vendor-Manufacturer worksheet.
Cost	The installed cost of the equipment.
Warranty Duration	The length of the warranty on the equipment
Anticipated Warranty Start Date	The estimated date of substantial completion. Will help define when the warranty will expire.

In addition to the information above, additional asset-specific attributes must be completed. The additional fields that need to be completed will be defined for you on the Assets Worksheet for each different type of asset. See the Equipment Attribute Sheets template for examples.

SPARE PARTS WORKSHEET

Spare parts or kits that are to be used in the performance of recommended preventive maintenance activities should be listed on the Spare Parts worksheet. This will enable JEA to keep an inventory of the items and enable preventive maintenance work orders to reference the spare part requirements.

Spare Part or Kit ID	A unique identifier for the Spare Part of Kit
Spare Part / Kit Description	A useful description to help users of the CMMS and/or maintenance crews identify what is needed to perform the preventive maintenance task.
Vendor/Manufacturer ID	The unique identifier for Vendor or Manufacturer of the item. The identifier should reference the Vendor-Manufacturer worksheet.
Kit Contents	If the item is actually a kit that contains multiple items, the quantity and a brief description of each item in the kit should be listed individually.
Asset ID(s)	The list of Assets that the spare parts are applicable to. The Asset IDs are defined in the Assets worksheet.

PREVENTIVE MAINTENANCE WORKSHEET

All recommended preventive maintenance (PM) activities for the equipment provided must be compiled on the Preventive Maintenance worksheet. This will facilitate the creation of the necessary preventive maintenance schedules for the equipment in the CMMS. It will also help JEA identify the specific tasks and materials that are involved in completing future PM work orders. The Preventive Maintenance worksheet contains two sections. The general list of preventive maintenance activities and their frequencies should be entered in the Preventive Maintenance Header. The tasks that a maintenance worker would execute as part of each PM should be entered into the Preventive Maintenance Tasks.

Preventive Maintenance Header

PM ID	Please specify a unique number for each recommended preventive maintenance (PM) activity. The first PM should have an ID of 1, and you should increment from there. The individual tasks that comprise the activity will be listed separately below and will reference this identifier.

PM Description	A useful description of the PM activity. It should also contain the frequency that the activity should be performed.
Frequency - Calendar	If the frequency is calendar based (every week, 2 weeks, month, etc) please enter the frequency.
Frequency - Runtime	If the PM should be scheduled based on equipment run-time, please enter the runtime interval at which the PM should be performed.
Applicable Asset ID(s)	In order to create the PM schedules in the CMMS, a list of the applicable Asset IDs are needed. If a PM is applicable to several assets that you are supplying, please list all those Asset IDs and create rows as necessary in Excel.

Preventive Maintenance Tasks

PM ID	This is the identifier from the Preventive Maintenance Header (above).
Task Number	A numeric identifier for each task listed under a scheduled PM. The first task should be "10" and each successive task should be incremented by 10.
Task Description	A useful description of the task. It is not necessary or desirable for this to be overly detailed. It is meant to be a checklist that a person could use in performing the recommended PM activities. The examples provided are an indicator of the desired level of detail.
Spare Part / Kit ID	If the task likely will require spare parts, the spare parts should be listed here. The ID that should be entered here should come from the Spare Parts worksheet.
Spare Part / Kit Quantify	The quantity of the specified parts that are likely to be necessary to complete the PM task
Special Tools / Equipment Description	If any special or unusual tools or equipment are necessary to perform the maintenance task, a description should be entered here.

END OF SECTION

SECTION 01 35 43

STORMWATER POLLUTION PREVENTION / NPDES REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

Stormwater Pollution Prevention Plan requirements and recommendations under the NPDES program for construction projects located in Florida.

1.02 PURPOSE

The purpose of this section is to outline minimum requirements for stormwater pollution prevention as required under the NPDES program. There may be more stringent local government or Owner requirements for Erosion and Sediment Control, which would be located in the Specifications or on the Drawings. The more stringent requirement governs.

1.03 ABBREVIATIONS

A. NPDES - National Pollution Discharge Elimination System

B. SWPPP - Stormwater Pollution Prevention Plan

C. NOI - Notice of Intent

D. NOT - Notice of Termination

1.04 DEFINITIONS

The term “NPDES Generic Permit” means the State of Florida Department of Environmental Protection (FDEP) Generic Permit For Stormwater Discharge from Large and Small Construction Activities.

1.05 CONSTRUCTION PROJECTS REQUIRING COMPLIANCE WITH NPDES GENERIC PERMIT

A. All projects 1 or more acres in size that discharge to offsite areas.

B. Smaller projects that are in the same construction corridor as larger construction projects where the larger project is 1 or more acre in size and is required to comply with the NPDES Generic Permit. In this case, even if the smaller project

is less than 1 acre in size, the smaller project must comply with the NPDES Generic Permit.

1.06 GENERAL REQUIREMENTS

A. Construction of this project is required to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) Generic Permit for Stormwater Discharge from Small and Large Construction Activities.

B. In order to meet NPDES requirements, the Contractor is responsible for preparing a Stormwater Pollution Prevention Plan (SWPPP), implementing, inspecting, maintaining, and reporting on all elements of the SWPPP, completing and submitting the required Notice of Intent (NOI) and Notice of Termination (NOT) forms as the Operator, and paying all associated fees. Copies of the NPDES Generic Permit, NOI, and NOT forms, and permit application fee information are available for download at dep.state.fl.us/water/stormwater/npdes/

C. The Contractor must include in the SWPPP the names and addresses of all subcontractors working on this project who will be involved with the major construction activities that disturb site soil or who implement a pollutant control measure. These subcontractors, in addition to the Contractor, shall comply with the requirements of the NPDES Generic Permit and any local governing agency having jurisdiction concerning erosion and sedimentation control, and shall sign a copy of the certification statement in the SWPPP.

D. The SWPPP shall describe and ensure the implementation of best management practices which will be used to reduce the pollutants in stormwater discharge associated with construction activity and to assure compliance with the terms and conditions of the NPDES Generic Permit. The erosion and sediment control measures shown on these Drawings are the minimum required and are to be installed prior to construction. The Contractor is responsible for complying with all applicable rules, regulations and water quality standards and may need to install additional controls to meet these requirements.

1.07 SWPPP IMPLEMENTATION AND SUBMITTAL REQUIREMENTS

A. The SWPPP shall be completed prior to submittal of the NOI and shall include the elements necessary to comply with the NPDES Generic Permit for construction activities administered by the FDEP and shall also include all local

governing agency and Owner requirements. There may be more stringent local government or Owner requirements for Erosion and Sediment Control, which would be located in the Specifications or elsewhere on these Drawings.

B. The Contractor must file the NOI with FDEP and the Owner at least two (2) business days prior to the start of construction. The Contractor shall also submit a copy of the NOI to the MS4 operator for all projects that discharge stormwater associated with construction activity to a municipal separate stormwater system (MS4). A copy of the NOI and a description of the project must be posted in a prominent place for public viewing at the construction site.

C. The SWPPP must be implemented at the start of construction. A complete copy of the SWPPP, including copies of all inspection reports, plan revisions, etc., must be retained at the project site at all times during working hours and kept in the permanent project records for at least three years following submission of the NOT.

D. Final Stabilization means that all soil disturbing activities at the site have been completed, and that a uniform perennial vegetative cover (evenly distributed, without large bare areas) with a density of at least 70% for all unpaved areas and areas not covered by permanent structures has been established or equivalent permanent stabilization measures (such as geotextiles) have been employed. Once construction is completed and final stabilization has been achieved, the Contractor must file the NOT to FDEP, the Owner, and the MS4 operator within 14 days.

1.08 INSPECTIONS

A. It is the responsibility of the Contractor to assure the adequacy of site pollutant discharge controls. Between the time the SWPPP is implemented and final site stabilization is achieved, all disturbed areas and pollutant controls must be inspected at least once every seven calendar days and within 24 hours following a rainfall of 0.5 inches or greater. The inspections are to be conducted by the Contractor's qualified designated representative.

B. All inspections shall be documented in an inspection report that summarizes the scope of the inspection, the names and qualifications of personnel making the inspection; the date of the inspection; rainfall data; major observations relating to

the implementation of the SWPPP, and actions taken in order to ensure compliance with NPDES requirements and the SWPPP. Such reports shall identify any incidents of non-compliance and actions taken to bring the project into compliance. Where a report does not identify any incidents of non-compliance, the report shall contain a certification that the facility is in compliance with the NPDES requirements and the SWPPP. Each inspection report shall be signed and certified by each inspector.

1.09 UPDATING AND MODIFYING THE SWPPP

A. Based on inspection results, any modifications necessary to increase effectiveness of the SWPPP to an acceptable level must be made within seven calendar days of the inspection.

B. The SWPPP must be updated each time there are significant modifications to the pollutant prevention system or a change of contractors working on the project who disturbs site soil. For construction activities where the operator changes, the new operator shall file an NOI for coverage under this permit at least two (2) days before assuming control of the project and the previous operator shall file an NOT to terminate permit coverage in accordance with the NPDES Generic Permit. Amendments to the plan shall be prepared, signed, dated, and kept as attachments to the original SWPPP.

1.10 MINIMUM SWPPP PROVISIONS

A. Each SWPPP shall provide a description of pollutant sources and other information including a description of the nature of the construction activity; the intended sequence of major activities which disturb soils for major portions of the site; estimates of the total area of the site and the total area of the site that is expected to be disturbed by excavation, grading, or other construction activities; existing data describing the soil or the quality of any discharge from the site and an estimate of the size of the drainage area for each discharge point; a site map indicating drainage patterns and approximate slopes anticipated after major grading activities, areas of soil disturbance, an outline of areas which may not be disturbed, the location of major structural and nonstructural controls identified in the plan, the location of areas where stabilization practices are expected to occur, surface waters, wetlands, and locations where stormwater is discharged to

a surface water or MS4; and the latitude and longitude of each discharge point and the name of the receiving water(s) for each discharge point.

1.11 MINIMUM EROSION AND SEDIMENT CONTROL CONSTRUCTION REQUIREMENTS

A. Stabilize all construction site exits with coarse aggregate or other approved materials, in accordance with details on the Drawings. Other minimum construction requirements that need to be implemented in order to comply with the NPDES Generic permit include installation of sediment barriers down slope from construction activities that disturb site soil; constructing rock surface temporary parking areas; installation of sediment barriers down slope prior to clearing and grubbing; installation of sediment barriers on the down slope side of utility construction and soil stockpiles; and the installation of sediment barriers on the down slope side of grading activities.

B. Stabilization measures shall be initiated as soon as practicable, but in no case more than 7 days, in portions of the site where construction activities have temporarily or permanently ceased.

C. The Owner has the authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, trenching, borrow and embankment operations. The Owner also has authority to direct Contractor to provide immediate permanent or temporary erosion and sediment control measures.

D. The Contractor shall respond to erosion and sediment control maintenance requirements or implement additional measures to control erosion ordered by Owner or governing authorities within 48 hours or sooner if required at no additional cost to the Owner.

E. The Contractor shall incorporate permanent erosion control features into project at earliest practical time to minimize need for temporary controls.

F. For drainage basins with 10 or more disturbed acres at one time, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent control measures, shall be provided where attainable until final stabilization of the site. The 3,600 cubic feet of storage area per acre drained does not apply to flows from offsite areas and flows from onsite areas that are either undisturbed or have undergone final stabilization where such flows

are diverted around both the disturbed area and the sediment basin. For drainage basins with 10 or more disturbed acres at one time and where a temporary sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent controls is not attainable, a combination of smaller sediment basins and/or sediment traps and other BMPs should be used. At a minimum, silt fences, or equivalent sediment controls are required for all sideslope and downslope boundaries of the construction area.

G. Water trucks shall be used as needed during construction to reduce dust generated on the site. Dust control must be provided by the Contractor and shall be in compliance with applicable local and state dust control regulations.

1.12 MAINTENANCE REQUIREMENTS

A. Maintain all erosion and sediment control measures throughout construction. Repair or replace all damaged sediment barriers. Remove accumulated sediment along all silt fences where the height of the sediment exceeds one-third of the height of the silt fence. Inspect all temporary and permanent grassing areas and re-grass where there are bare spots, washouts, or unhealthy growth.

B. At the completion of construction, once final stabilization has been achieved, clean all accumulated sediment from all storm structures, pipelines, and stormwater ponds. Remove all temporary sediment controls upon receipt of authorization to remove has been received from the Owner or Engineer. Note that this may not occur for some time after construction activities have been completed, in order to ensure their removal has not occurred until final stabilization has been achieved to the satisfaction of the Owner and Engineer.

1.13 STORMWATER DISCHARGE PROVISIONS

A. Non-stormwater components of site discharge must be clean water. Water used for construction, which discharges from the site, must originate from a public water supply or private well approved by the governing local agency. Water used for construction that does not originate from an approved public supply must not discharge from the site. Allowable non-stormwater discharges include discharges from fire fighting activities; Fire hydrant flushing; Water used to wash vehicles or control dust; Water flowing from potable sources and water line flushing; Irrigation drainage; and runoff from pavement wash down where spills

or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents have not been used.

B. Solid materials, including building materials, are not allowed to be discharged from the site with stormwater. All solid waste, including disposable materials incidental to the major construction activities, must be collected and placed in containers. The containers shall be emptied periodically by a contract trash disposal service and hauled away from the site.

C. Substances that have the potential for polluting surface and/or groundwater must be controlled by whatever means necessary in order to ensure that they do not discharge from the site. As an example, special care must be exercised during equipment fueling and servicing operations. If a spill occurs, it must be contained and disposed so that it will not flow from the site or enter groundwater, even if this requires removal, treatment, and disposal of soil in accordance with local and state regulations.

D. All personnel involved with construction activities must comply with state and local sanitary or septic system regulations. Temporary sanitary facilities shall be provided at the site throughout the construction phase for use by all construction personnel and shall be serviced by a commercial operator at least once a week.

E. Discharges resulting from groundwater dewatering activities at construction sites are permitted provided the groundwater is free of sediments, is not contaminated, and dewatering occurs in accordance with state and local governing agency regulations.

F. Chemicals, paints, solvents, fertilizers, and other toxic material must be stored in waterproof containers. Except during application, the contents must be kept in trucks or within storage facilities. Runoff containing such material must be collected, removed from the site, treated, and disposed at an approved solid waste or chemical disposal facility.

G. The discharge of hazardous substances or oil in the stormwater discharge(s) from a facility or activity shall be prevented. This does not relieve the operator of the reporting requirements of 40 CFR part 117 and 40 CFR part 302. The operator shall submit within 14 calendar days of knowledge of the release a written description of: the release (including the type and estimate of the amount

of material released), the date that such release occurred, the circumstances leading to the release, and remedial steps to be taken. The SWPPP must be modified within 14 calendar days of knowledge of the release to: provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and the plan must be modified where appropriate.

END OF SECTION

SECTION 01 37 00

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 PRELIMINARY SCHEDULE OF VALUES

A. Schedule Items

The apparent low bidder will prepare a preliminary schedule of values within the time frame referenced in the instructions to bidders. Each item in the schedule includes the complete structure; piping and valves (including pipe in the yard within 5 feet of the structure); equipment and local control panels furnished by equipment manufacturers. All electrical work will be included in the electrical item unless noted otherwise. All field instruments will be included in the instrumentation item. The preliminary schedule of values will include, but not limited to, the lump sums for the following items:

1. Mobilization
2. Demolition: This item includes all work related to demolition, removal, and abandonment of existing equipment, structures, piping and valves. Major items include the demolition of the three (3) existing pumps and motors, existing ventilation system, existing internal and external lighting systems, existing sanitary piping including plumbing fixtures, existing electrical powering system, mechanical bar screen, existing sluice gates, existing screens, existing sump pumps, and existing instrumentation.
3. Pump Building Modifications: This item includes building modifications to the proposed electrical room, new doors, concrete slab and foundation work, coatings, HVAC, ventilation, plumbing, monorail, roofing, elevated platforms, sluice gates, grating and handrail.
4. High Service Pumping: This item includes all work related to the installation of the three (3) new high service pumps, VFDs for new high service pumps, concrete slabs, and associated piping, valves and appurtenances.

5. Diesel Engine Driven Pump: This item includes all work related to construction of a new concrete pad and installation of a new diesel engine driven pump with fuel tank, piping and valves, electrical gear, controls and other appurtenances as shown in the drawings and specified herein.

6. Emergency Power Generator and Fuel Tank: This item includes all work related to the construction of a new concrete generator pad and installation of a new stand-by generator, fuel tanks, fuel piping and valves, electrical gear, controls, and other appurtenances complete as shown in the drawings and specified herein.

7. Electrical: This item includes all the electrical work on the project including all motor control centers, conduit and wire, lighting, emergency power generation systems and fiber optic communication systems.

8. Instrumentation: This item includes all field instruments, PLC control panels and the complete Supervisory Control System including all control stations.

9. Station Piping: This item includes all station piping, valves and backflow preventers, metering stations, all other in-ground facilities and above ground piping facilities not specifically included with any of the other items included in the schedule.

10. Site Work: This item includes demolition, mobilization, demobilization, concrete, start-up, grading, paving, drainage, sidewalks, driveways, storm water drainage structures, manholes, O&M Manuals, As-builts and site restoration.

11. Asset Management: This item includes contractor submission of completed Asset Management tables in accordance with JEA requirements.

12. Start-up: This item includes all testing and start up services.

13. O&M Manuals: This item includes submission of O&M Manuals, in compliance with this technical specifications manual.

14. Asbuilts: This item includes submission of as-builts in ACAD format.

15. Demobilization

B. Bid Breakdown

1. Submit to the Owner's Representative a breakdown of all lump-sum bid items into the major and minor portions of work and include material and equipment costs. The breakdown shall be by Process area and specification division within each Process area. The breakdown shall be done in accordance with a form established by the Contractor and acceptable to the Owner.

2. This breakdown shall be the basis of all progress payments. Fill in amounts or quantities where unit quantities are shown, i.e., L.F., C.Y., S.F. The Contractor may submit an alternate form, providing it is at least as detailed as the enclosed form.

3. Form:

				CONTRACT			THIS MONTH		TO DATE	
Activity No.	PROCESS NO.	SPEC DIV	DESCRIPTION	QTY	NIT PRICE	TOTAL COST OF ITEM	QTY	AMOUNT THIS MONTH	QTY	TOTAL COST OF ITEM

1.02 FORM & CONTENT OF SCHEDULE OF ASSET VALUES

A. A spreadsheet will be provided that includes the assets to be accounted for in the Schedule of Asset Values.

B. For each asset listed, provide a constructed cost which will include an allocation of construction activities including, but not limited to, demolition, sitework, specialties, materials, labor, general conditions, and overhead and profit associated with the construction of the asset.

C. The combined value of the assets will equal the bid price for the project, and will require adjustments as necessary due to change orders. The schedule of asset values will be updated on a monthly basis and will be included in the monthly pay request application for approval.

D. The Owner reserves the right to edit this list prior to the first pay request application, and may add up to 10 percent more items than have been identified on the attached list.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Testing and inspection agencies and services.

C. Control of installation.

D. Defect Assessment.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.

1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

1.03 TESTING AND INSPECTION AGENCIES AND SERVICES

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 TESTING AND INSPECTION

A. Testing Agency Duties:

1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
2. Perform specified sampling and testing of products in accordance with specified standards.
3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
5. Perform additional tests and inspections required by Architect.
6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
a. To provide access to Work to be tested/inspected.
b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
c. To facilitate tests/inspections.
d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.03 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 01 41 26

PERMITS AND FEES

1.01 GENERAL

A. Obtain and pay for all permits and licenses as provided for in the General Conditions, except as otherwise provided herein.

B. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.

C. Comply with all conditions specified in each of the permits and licenses.

D. A copy of the permits obtained by the Owner will be furnished to the Contractor.

2.01 PERMITS BY OWNER

A. The Owner will obtain and pay for the following permits:

1. Florida Department of Environmental Protection (FDEP) Application for the Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System.

2. St. Johns River Water Management District (SJRWMD) Environmental Resource Permit (ERP) letter modification.

3. City of Jacksonville:

a. City of Jacksonville Building Department Permit – The Owner will make the preliminary submittal for review and comments. The contractor will be responsible for obtaining and coordinating, and JEA will pay for the final permit.

b. City of Jacksonville Site Engineering Plan Approval (10-set)

B. Permits by Contractor

1. City of Jacksonville Site Work and Right-of-Way Permits.

2. The Contractor will obtain, coordinate, and pay for City of Jacksonville demo, mechanical, electrical and other trade permits, and Florida

Department of Environmental Protection (FDEP) Stormwater Notice of Intent, and site dewatering.

3. If dewatering is required, the Contractor shall coordinate with the St. Johns River Water Management District regarding the applicable rules and regulations. If a dewatering permit is required, the Contractor shall prepare an application to the District and pay any fee.

END OF SECTION

SECTION 01 45 00

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 REQUIREMENTS

A. The Contractor will contract with, provide and pay for the services of an independent testing laboratory to perform certain specific testing as required by the Contract Documents, specified in the Specifications; or as specified here-in. This testing will include:

1. Field Density Tests, Concrete Test Cylinders, Grout Prisms, Mortar Cubes, Limerock Bearing Ratios, Grain Size Analysis, and Moisture-Density Relationships (Proctor).

This testing does not include tests required to prove satisfactory operation of equipment or materials, pressure leakage and infiltration/exfiltration tests, bacteriological tests, or any tests specified to be made by the Contractor. Testing of pipe material and pipe, proof of design tests, pressure tests and bacteriological testing are specified in other sections of the Specifications and are the responsibility of the Contractor. Any and all tests which have to be repeated because of the failure of the tested material to meet Specifications shall be paid for by the Contractor and the costs of any such retests shall be deducted from payments due the Contractor. JEA will be responsible for taking and analyzing water samples for bacteriological clearance. The Contractor shall be responsible for cleaning and chlorinating all components and providing a means for JEA to take water samples as required.

The results of all the testing reports shall be copied to the Contractor and the Owner.

1.02 LABORATORY DUTIES: LIMITATIONS OF OWNER

A. The laboratory is not authorized to:

1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of the work.

1.03 CONTRACTOR'S RESPONSIBILITY

A. The Contractor shall:

1. Cooperate with laboratory personnel, and provide access to the Project.

2. Secure and deliver to the laboratory adequate quantities of samples of materials that are representative of the whole of the material proposed to be used and which require testing.

3. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes that require control by the testing laboratory.

4. Furnish incidental labor and facilities:

   a. To provide access to Project to be tested.

   b. To obtain and handle samples at the Project site or at the source of the product to be tested.

   c. To facilitate inspections and tests.

   d. For storage and curing of test samples.

B. The Contractor shall notify in writing the Owner and the Testing Laboratory in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspection cannot be performed after such notice, the Contractor shall reimburse the Owner for laboratory personnel and travel expenses incurred due to Contractor's failure to adequately provide such notice.

C. The Contractor shall employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience.

D. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefore, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval.

E. Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Owner's or Engineer's acceptance of a Supplier of materials or equipment proposed to be incorporated in the Work, or of

materials or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

F. All inspections, tests or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to Owner and Contractor.

G. If any Work (including the work of others) that is to be inspected, tested or approved is covered without written concurrence of Owner’s Representative, it must, if requested by Engineer, be uncovered for observation. Such uncovering shall be at Contractor's expense unless Contractor has given Owner’s Representative timely notice of Contractor's intention to cover the same and Owner’s Representative has not acted with reasonable promptness in response to such notice.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01 45 10

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

Quality control, quality assurance

1.02 QUALITY CONTROL

A. It is the Contractor's responsibility to perform all work to a degree and in a manner that satisfies and complies with the Project requirements. In order to fulfill this responsibility, the Contractor is required to have an approved Quality Control Program, including testing, as part of his Contract work in accordance with the Contract Documents and to submit details of his Program to the Engineer for review and approval prior to commencing any construction operations. The submittal shall include detailed information on locations and number of all tests, etc., that will be necessary for the Contractor to make his own determination that the work is being performed in compliance with the Project requirements.

B. As part of the Contractor’s Quality Control Program included as part of his work, the Contractor shall employ and pay for an independent, approved soils testing laboratory to perform testing services outlined in these Contract Documents.

C. The Contractor's Quality Control Program shall include, but not be limited to, the following in addition to the type and frequency of tests as required by the technical specifications:

1. Piping and structural excavation, bedding and backfill materials and density quality control testing.

2. Determination of compactive effort needed for compliance with the density requirements.

3. Portland cement concrete and asphalt paving quality control testing including design mix review, materials, field slump and air content, and field and lab cured strength samples and testing.

D. In addition to Quality Control Testing, the Contractor shall be responsible for required testing or approvals for any work (or any part thereof) if laws or regulations of any public body having jurisdiction specifically require testing, inspections or approval. The Contractor shall pay all costs in connection therewith and shall furnish the Engineer the required certificates of inspection, testing or approval. The Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Owner or Engineer acceptance of a supplier of materials or equipment proposed to be incorporated into the work.

E. Any design or testing laboratory utilized by the Contractor shall be an independent laboratory acceptable to the Owner and the Engineer, approved in writing, and complying with the latest edition of the "Recommended Requirements for Independent Laboratory Qualification", published by the American Council of Independent Laboratories.

F. Testing laboratories, whether provided by the Owner or the Contractor, shall promptly notify the Engineer and the Contractor of irregularities or deficiencies of work, which are observed during performance of services. Laboratories shall submit two (2) copies of all reports directly to the Engineer and two (2) copies to the Contractor.

1.03 QUALITY ASSURANCE

A. In addition to the services provided by the laboratory paid for by the Contractor as a part of his work, the Owner, at his sole discretion, may employ an additional independent soils laboratory as part of Owner's Quality Assurance Program to verify that the work meets the requirements of the Contract Documents. The Owner furnished Quality Assurance testing may include the type and frequency of tests as required by the technical specifications. The Owner reserves the right to have additional tests made beyond those specified in the Contract Documents. The Contractor shall cooperate with the Owner and make the work and samples available for Owner testing at no additional cost in case the Owner chooses to have additional Owner furnished testing performed. It is the sole responsibility of the Contractor to see that his work meets all provisions of the Contract Documents.

B. The Contractor shall cooperate with the soils laboratory personnel and provide access to the work to be tested. The Contractor shall notify the Engineer and Owner's testing laboratory sufficiently in advance of operations to allow scheduling of tests. The Contractor shall furnish casual labor and facilities to obtain and handle samples at the site and to store and cure test samples as required.

1.04 TESTING OF MATERIALS

A. Unless otherwise specified, all materials shall be sampled and tested in accordance with the latest published standard methods of ASTM in effect at the time bids are received. If no ASTM Standards apply, applicable standard methods of the Federal Government or of other recognized agencies shall be used.

B. Test of materials shall be made by a representative of the Contractor, unless otherwise provided. Testing of equipment shall be the responsibility of the Contractor or an authorized manufacturer's representative. All test results shall be furnished to the Engineer in writing. The Contractor shall provide facilities required to collect and forward samples. The Contractor shall furnish the required samples without charge.

C. The Contractor shall not make use of or incorporate in the work, the materials represented by the sample until tests have been made and the material found to be in accordance with the requirements of the Specifications.

D. Materials to be tested and the applicable test procedure shall be as outlined in the individual sections of these Specifications.

1.05 SOURCE AND QUALITY OF MATERIALS AND EQUIPMENT

A. The source of materials to be used shall be in accordance with the Contract Documents and as approved by the Engineer before delivery. The approval of the source of any material shall continue as long as the material conforms to the Specifications.

B. All material not conforming to the requirements of the Specifications shall be considered as defective and shall be removed from the work. If in place, faulty materials shall be removed by the Contractor at his expense and replaced with

acceptable material unless permitted otherwise by the Owner. No defective materials which have been subsequently corrected shall be reused until approval has been given.

C. Upon failure of the Contractor to comply immediately with any order of the Engineer to remove and replace defective material, the Owner shall have authority to remove and replace defective materials, and to deduct the cost of removal and replacement from any monies due or to become due to the Contractor. Failure to reject any defective materials or work at the time of installation shall in no way prevent later rejection when such defects are discovered, nor obligate the Owner to final acceptance.

1.06 ADDITIONAL TESTING

A. In addition to soils laboratory and materials testing, the Contractor shall perform other testing called for in the Contract Documents including but not limited to piping, pressure, leakage, infiltration and exfiltration, as appropriate. Bacteriological samples will be taken and tested by JEA, however the Contractor is required to clean and chlorinate and provide sample points.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 51 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

Construction facilities, controls, temporary utilities, project identification signs, field office and storage sheds, storage of materials and equipment

1.02 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

A. Responsibility

All construction facilities and temporary controls remain the property of the CONTRACTOR establishing them and shall be maintained in a safe and useful condition until removed from the construction site.

B. Temporary Electric Service (NOT USED)

C. Temporary Heating (NOT USED)

D. Temporary Ventilation (NOT USED)

E. Temporary Telephone

1. The Contractor shall provide the site superintendent with a mobile phone or radio so that he can be reached at all times.

F. Temporary Water

1. There is existing hydrants in the immediate area of proposed construction and the Contractor will coordinate with JEA to obtain a temporary meter for any potable water needs during the project.

2. As may be necessary, the Contractor shall provide a water truck for all necessary water during construction.

G. Temporary Sanitary Facilities

Provide temporary toilet facilities as required. Maintain these during the entire period of construction under this Contract for the use of all construction personnel on the job. Enough chemical toilets shall be provided to conveniently

serve the needs of all personnel. Chemical toilets and their maintenance shall meet the requirements of State and local health regulations and ordinances.

H. Temporary Pumping and Site Drainage

The Contractor shall keep the site free from water at all times to permit continuous access and to prevent damage to the work.

I. Material Hoists and Cranes

1. Provide material hoists required for normal use by all trades and employ skilled hoist operators. Provide all necessary guards, signals, safety devices, etc., required for safe hoist operation. The construction and operation of material hoists shall be in accordance with the applicable ANSI Standards, the "Manual Code of Accident Prevention in Construction" of the Associated General Contractors of America, OSHA, and of other Federal, State, and municipal codes or ordinances. The Contractor shall prohibit the use of hoists for transporting personnel. Hoists shall be located to avoid risk of damage to completed work.

2. Special rigging and hoisting facilities shall be provided by each trade requiring their use.

J. Temporary Runways, Scaffolding, and Ladders (NOT USED)

K. Temporary Chutes (NOT USED)

L. Security

Full time watchmen will not be specifically required as a part of the Contract, but the Contractor shall provide inspection of work area daily and shall take whatever measures are necessary to protect the safety of the public, workmen, and materials, and provide for the security of the site, both day and night.

M. Access Roads and Parking Areas

The Contractor shall maintain all access roads and parking areas. The contractor shall ensure all accesses to existing homes, drives, and streets are unobstructed throughout construction.

N. Dust and Mud Control

Take all necessary precautions to control dust and mud associated with the work of this Contract, subject to the approval of the Engineer. In dry weather, spray dusty areas daily with water or weekly with oil in order to control dust. Take necessary steps to prevent the tracking of mud onto adjacent streets and highways.

O. Traffic Regulation (NOT USED)

P. Project Identification Signs

1. As soon as practicable after award of contract, furnish and erect two signs for the project, placed at locations determined by OWNER. Signs shall be erected when the work is started and shall be suitably supported, braced, and maintained, and shall be removed upon completion of the project or when directed by the OWNER.

2. The signs shall be identical and shall state the title of the project and the names of the Owner, Engineer and the Contractor. Submit to the OWNER for approval the proposed sign lettering (fonts, size) and text prior to fabricating the signs.

3. The sign shall be 1" exterior grade plywood. All surfaces shall be painted with three coats of white exterior grade paint and neatly painted black letters.

4. No other signs will be permitted.

Q. Contractor's Field Office and Storage Sheds

The Contractor shall provide field office and storage sheds as required for the performance of the Work and protection of materials and equipment.

R. Owner / Engineer Field Office (NOT USED)

S. Removal of Temporary Construction

Remove the various temporary facilities, services, and controls and legally dispose of them as soon as the Engineer deems permissible. Portions of the site used for temporary facilities shall be properly reconditioned and restored to a condition acceptable to the Engineer.

1.03 MATERIALS AND EQUIPMENT

A. Transportation and Handling

1. Manufactured materials and products shall be delivered to the project site as needed for installation, undamaged, in original packages, containers, or bundles, as packaged by the manufacturer with manufacturer's name, brand, seals, and labels intact.

2. Materials other than those designated within the Specifications or approved by the Engineer shall not be delivered to the project site.

B. Storage and Protection

The Contractor shall be responsible for protection and preservation of all materials until final acceptance of the Project. Any damage to work prior to acceptance shall be remedied by the Contractor at no additional cost to the Owner.

C. Protection of Completed Work

Provide temporary weather-tight enclosures to protect work from damage by the elements, and protect finished surfaces to prevent any damage resulting from the work of any trade.

1.04 SUBMITTALS

A. Prior to installation of construction facilities and temporary controls, submit the following items for review and approval:

1. Project identification sign - provide proposed text, layout, and sizing of all required signs. Coordinate sign with JEA project outreach.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations.

E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:

1. Containing lead, cadmium, or asbestos.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.02 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 61 16

VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for Indoor-Emissions-Restricted products.

B. Requirements for VOC-Content-Restricted products.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

1.03 DEFINITIONS

A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.
   3. Flooring.

B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.

C. Interior of Building: Anywhere inside the exterior weather barrier.

D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).

C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.

D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.

E. CHPS (HPPD) - High Performance Products Database; Current Edition at www.chps.net/.

F. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

G. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).

H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

I. SCS (CPD) - SCS Certified Products; Current Edition.

J. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.06 QUALITY ASSURANCE

A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) certification.
      b. Current SCS (CPD) Floorscore certification.
      c. Current SCS (CPD) Indoor Advantage Gold certification.
      d. Current listing in CHPS (HPPD) as a low-emitting product.
      e. Current CRI (GLP) certification.
      f. Test report showing compliance and stating exposure scenario used.
   4. Product data submittal showing VOC content is NOT acceptable evidence.
   5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.

B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
   1. Inherently Non-Emitting Materials.

C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
   2. Joint Sealants: SCAQMD 1168 Rule.
   3. Paints and Coatings: Each color; most stringent of the following:
      a. 40 CFR 59, Subpart D.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 74 23

CLEANING UP

PART 1 GENERAL

1.01 SUMMARY

A. Execute cleaning during progress of Work and at completion of Work.

B. Refer to specification sections for specific cleaning for Products or Work.

1.02 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with local codes, ordinances, regulations, and anti-pollution laws. Do not burn or bury rubbish or waste materials on Project site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use only those cleaning materials which will not create hazards to property and persons or damage surfaces of material to be cleaned.

B. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

PART 3 EXECUTION

3.01 CLEANING DURING CONSTRUCTION

A. At all times maintain areas covered by the contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.

B. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and

public properties are maintained free from accumulations of waste materials and rubbish. Unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

C. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

D. Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public access roads to the site of any material falling from the haul trucks.

E. Where material or debris has washed or flowed into or been placed in existing watercourses, ditches, gutters, drains, pipes structures, work done under this contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc., shall, upon completion of the work, be left in a clean and neat condition.

F. On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools, and machinery or other construction equipment furnished by him; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses, and other buildings used by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

G. Provide on-site containers for collection and removal of waste materials, debris, and rubbish in accordance with applicable regulations.

3.02 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

    d. Remove tools, construction equipment, machinery, and surplus material from Project site.

    e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

    f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

    g. Sweep concrete floors broom clean in unoccupied spaces.

    h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

    i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

    j. Remove labels that are not permanent.

    k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and

other foreign substances.

l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

p. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in JEA's Solicitation Documents.

D. Electrical Contractor shall touch-up paint or repaint damaged finishes on electrical items delivered to Project with finish coat of paint. Owner's Representative will make final determination of items to be repainted or touched-up.

E. Prior to substantial completion or Owner occupancy, Contractor with Owner's Representative and Owner**,** shall conduct inspection of sight-exposed interior and exterior surfaces and work areas to verify Work and site is clean.

3.03 CLEANING AND DISINFECTION OF CONCRETE TANKS

A. Clean thoroughly, using water under pressure, before disinfecting.

1. Isolate reservoir from system to avoid possibility of contaminating materials entering distribution system.

2. Cleaning shall:

a. Remove deposits of foreign nature.

b. Remove growths.

c. Broom walls, floor, and ceiling.

d. Avoid damage to structure.

e. Avoid contamination by workers and equipment.

3. Water used in cleaning reservoir shall be wasted before adding chlorinating agent to reservoir.

3.04 CLEANING OF WASTEWATER TANKS

A. Wet wells, tanks, and basins shall be washed down and swept before wastewater or process wastes are allowed to enter.

END OF SECTION

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SECTION 01 78 00

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SECTION INCLUDES

Substantial completion requirements, clean-up, final completion requirements, closeout submittals

1.02 CLEAN-UP OPERATIONS

A. The entire project site shall be thoroughly cleaned at the completion of the work.

B. The Contractor shall be responsible for the removal of excess dust and mud created by the construction project from all sidewalks, streets, and highways as directed by the Owner. Equipment to clean these surfaces shall be subject to approval by the Owner.

1.03 SUBSTANTIAL COMPLETION REQUIREMENTS

A. Complete the following before requesting the inspection for certification of substantial completion.

1. Submit as-built drawings.

2. Deliver tools, spare parts, extra stocks of material and similar physical items to the Owner.

3. Complete required cleaning and testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities and services from the project site, along with construction tools and facilities, mock-ups, and similar elements.

4. Complete final cleaning up requirements, including touch-up painting of marred surfaces.

5. Touch-up and otherwise repair and restore marred exposed finishes.

B. Work is not substantially complete until regulatory agency letters of clearance for placing systems into service are received by the Owner.

1.04 CLOSEOUT SUBMITTALS

A. Upon completion of the project, or portions thereof, the Contractor shall transfer to the Owner all applicable items accumulated throughout construction. These include but are not limited to the following items:

1. Service manuals, installation instructions, special tools, and specialties.
2. Spare parts ordered as part of this Contract.
3. Submittal of the Material and Workmanship Bond.
4. Submittal of manufacturers' guarantees, bonds, and letters of coverage extending beyond the time limitations of the Contractors' guarantee.
5. Delivery of any salvaged or borrowed materials or equipment to the Owner.
6. Record documents of completed facilities.
7. All keys to all doors, gates, and equipment.
8. Checklist indicating satisfactory completion of all unfinished items from the final inspection.
9. Waivers of lien.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 78 25

STATION TESTING, STARTUP AND COMMISSIONING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide planning, and functional completion testing, as indicated and specified. Section includes:

1. Station Checkout Plan

2. Functional Completion Testing including coordination with the Vendors for them to provide their services as contracted by the Owner.

B. It is intended that the Owner will perform its own startup and commissioning of the final improvements at the Timuquana Rd Pump Station after the control panels (provided by the Contractor) are completed and installed. Contractor shall be responsible for testing the functionality of each new component. Contractor shall assist JEA with the overall station startup once the control panels are completed.

1.02 DEFINITIONS

A. The Station Checkout Plan (the Plan) incorporates all aspects of functional completion testing, startup, commissioning, performance testing, training, and reliability tests to ensure the facility operates properly and meets design intent and performance.

B. Functional Completion Testing is testing of the equipment and unit process systems to confirm that construction and installation has been completed in anticipation of initial startup of the equipment and unit process systems. Functional Completion Testing includes:

1. Physical Checkout shall be defined as the process of physically inspecting products after they have been installed in the Work to determine if the Products have been properly and completely installed, and are ready for Field and/or Functional Testing. The requirements for Physical Checkout are contained in the pertinent technical specification(s) (if applicable).

2. Field Testing shall be defined as testing that is performed by the Contractor, with Supplier assistance, on Products after they have been installed in the Work, and after the performance of physical checkout, for the purpose of proving that the tested Products meet the requirements of the pertinent technical specifications. Administrative and minimum technical requirements for field testing are specified in Paragraph herein, while additional technical requirements are contained throughout the technical specifications. The test criteria are specified herein.

C. For the purposes of this specification, Startup shall be defined as the operation of equipment or unit process systems using clean water, air, or other fluids and gases as necessary to demonstrate the operation of the equipment or unit process systems with other equipment that is a part of, or a treatment process for the Facility. Administrative and minimum technical requirements for startup are specified herein. It is the Owner's intent to conduct the Start-up of the project, however, this does not release the Contractor from responsibilities to have the equipment totally prepared for the start-up.

D. For the purposes of this specification, Commissioning shall be defined as the operation of equipment or unit process systems using process liquids or process solids, plant support equipment, and plant utilities to demonstrate equipment or unit process systems are capable of processing water at specified flows and conditions for a sustained period of operation as required by this section or equipment or unit process systems specifications. Successful Commissioning shall determine that the equipment or unit process systems are ready to begin Performance Testing. Administrative and minimum technical requirements for Commissioning are specified herein, while additional technical requirements are contained throughout the technical specifications. It is the Owner's intent to conduct the Commissioning of the project; however, this does not release the Contractor from responsibilities to have the equipment totally prepared for the commissioning.

E. Performance Testing is defined as a test to demonstrate the specified throughput of the equipment and unit process systems while maintaining regulatory compliance with Federal, State, and Local government regulations and minimum compliance with the equipment or unit process systems performance requirements and guarantees.

F. The Testing and Checkout Coordinator shall be defined as the person provided by the Contractor to coordinate and oversee the total spectrum of testing and inspection

activities required by the Contract Documents. The Testing and Checkout Coordinator shall have been in responsible charge of two similar Projects in the last four to six years.

1.03 ROLES AND RESPONSIBILITIES

A. The Contractor shall provide all outside services, materials, labor, supplies, test equipment and other items necessary to perform the Station Testing, Startup and Commissioning as specified herein. In addition, the Contractor shall arrange for and provide the participation or assistance of survey crews, quality control technicians, and required governmental agency representatives.

B. The Owner had contracted for certain Supplier's representative's activities to assist with installation, for vendor training and other services. This information will be provided to the General Contractor. Timing for the performance of these services is to be defined in the Contractors Checkout Plan, specified herein.

C. The Owner will review and comment on the Contractor's deliverables, participate in the physical inspection activities, witness the shop and field testing, witness functional testing, maintain the permanent record of all testing results, and provide verification of conformance to the specifications. The Owner's right to perform inspections, witness tests or monitor or assess the Work and activities does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents nor does it imply completion of the Work.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01 33 00.

1. Submit a Station Checkout Plan.

1.05 STATION CHECKOUT PLAN

A. The Contractor shall be responsible for preparing, coordinating, and executing the Plan.

1. The Contractor shall use the resources of the equipment and unit process systems suppliers in this work, particularly for specific equipment and unit process systems.

2. An initial draft of the Plan shall be submitted as indicated here:

a. The initial draft Plan for the Facility shall be completed and submitted by the Contractor to the Owner for review as defined in Section 01 33 00.

b. The Contractor shall incorporate the Owner's comments into the revised Plan within 30 days of receiving comments, and reissue the Plan to the Owner.

c. The Contractor shall regularly schedule meetings with the Owner to review and coordinate activities required by the Plan.

B. The Plan shall define:

1. The logical and systematic performance of physical inspections, field and functional tests, including:

a. A chronological schedule of all testing and inspection activities.

b. A checklist of all inspection and testing activities broken down by location, discipline, system, and device or item.

c. All blank forms proposed by the Contractor for verification or recording of the functional completion testing**.**

d. An index which cross references the forms to their intended application(s).

e. A list of all supplier certifications, including those required by the applicable technical specifications. Provisions shall also be included for retesting, in the event it is required.

2. A list of participants in functional completion testing, startup, commissioning, and performance testing**.**

3. A list of special test equipment required for functional completion testing, startup, commissioning, and performance testing.

4. Sources of the test media (water, power, air.) for functional completion testing.

5. The proposed method of delivery of the media to the equipment to be tested during functional completion testing.

6. Temporary or interim connections for the sequencing of multiple units during functional completion testing.

7. Ultimate disposal of the test media after functional completion testing,

C. The plan shall be reviewed by the Owner, modified or revised as necessary by the Contractor, then re-reviewed by the Owner. The Contractor shall continue to update the Plan, working in conjunction with the Owner, prior to the start of the scheduled equipment checkout and functional testing activities as specified in Paragraph 1.08 herein. Each specific element of the plan must receive review or comment by the Owner, two weeks prior to the actual commencement of testing as defined herein.

D. The Contractor shall designate, in the Plan, a Testing and Checkout Coordinator, to coordinate and manage the activities defined in the Plan.

1.06 FUNCTIONAL COMPLETION TESTING

A. Functional Completion Testing shall be completed as construction and installation of equipment is completed to demonstrate that the equipment is ready for equipment and unit process systems startup.

1. Functional Completion Testing shall be done in a coordinated manner based on the Plan prepared by the Contractor.

   a. The Owner's operating and maintenance staff shall be allowed to observe and as necessary lead for the purposes of familiarization and training.

   b. Additional witnesses, such as the Engineer, may be present to represent the Owner.

2. Functional Completion Testing procedures and documentation forms shall be developed by the Contractor. The procedures shall include a listing of items inspected for Functional Completion Testing.

3. If any equipment or unit process systems do not meet Functional Completion Testing requirements, it shall be the responsibility of the Contractor and/or equipment suppliers to make the necessary corrections or replacements and repeat the test.

4. The equipment and unit process systems shall not be started up or put into service until the Functional Completion Testing is completed as evidenced by a completed Functional Completion Testing certificate for the equipment or subsystem.

5. Modifications to the equipment and unit process systems required to meet Functional Completion Testing requirements shall be provided, and all retesting shall be performed at no additional cost to the Owner.

6. A Functional Completion Testing Certificate shall be prepared by the Contractor for each piece of equipment or unit process and submitted to the Owner for review.

1.07 STARTUP

A. Startup activities for the Facility shall not be initiated until the requirements of Functional Completion Testing are completed for the equipment or unit process systems and have been documented by the General Contractor.

B. The requirements of this section shall be satisfactorily completed prior to beginning Commissioning for equipment and unit process systems.

1. It is intended that the Owner's operating and maintenance staff shall lead the startup activities and the Contractor's staff shall be available to assist for the purposes of familiarization and training.

2. Additional witnesses, such as the Engineer, may be present to represent the Owner.

C. For equipment or unit process systems that do not meet the specified Startup requirements, it shall be the responsibility of the Contractor and/or equipment or unit process systems suppliers to make the necessary corrections or replacements and repeat Startup at no additional cost to the Owner.

D. Startup Reports for each piece of equipment or unit process shall be completed and submitted by the Contractor to the Owner for review as defined in Section 01 33 00.

E. The Owner and the Contractor shall not begin Commissioning until Startup certificate is completed and is submitted.

1.08 COMMISSIONING

A. Commissioning activities for the Facility shall not be initiated until the requirements of Startup are completed for the equipment or unit process systems.

B. The requirements of this section shall be satisfactorily completed prior to beginning Performance Testing for equipment and unit process systems.

C. Commissioning shall be used by the Owner and equipment or unit process suppliers to adjust, fine tune, modify and prepare the equipment or system for continuous operation and Performance Testing.

1. Equipment shall not be operated without the guidance of qualified personnel having the knowledge and experience necessary to conduct proper operation thereof and obtain valid results.

2. All required adjustments, tests, operation checks, and Startup and Commissioning activities shall be provided by qualified personnel.

3. The Owner/Owner's operating and maintenance staff shall be responsible for coordinating the Startup and Commissioning of the equipment and unit process systems with the assistance of the Contractor and of equipment or unit process systems suppliers with the Owner in accordance with the Plan.

4. Additional witnesses, such as the Engineer, may be present to represent the Owner.

D. For equipment or unit process systems that do not meet Commissioning requirements, it shall be the responsibility of the Contractor and/or equipment or unit process systems suppliers to make the necessary corrections or replacements and repeat Commissioning at no additional cost to the Owner.

E. The equipment or unit process systems shall not be Performance Tested or otherwise placed into service until Commissioning is completed as evidenced by a completed Commissioning certificate for the equipment or unit process systems.

F. Commissioning Certificates for each piece of equipment or unit process shall be completed and submitted by the Contractor to the Engineer and Owner for review as defined in Section 01 33 00, Table 01 33 00-1.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.01 STATION CHECKOUT PLAN

A. The Plan shall include the following items as a minimum:

1. Cover Sheet with Station identification, title, date and other information as needed to properly identify the specific information for the Facility.

2. Status and revisions sheet with appropriate dates and signatures spaces to document the development and status of the document.

3. Table of Contents including Appendix.

4. Equipment and systems descriptions with anticipated break down for individual startup activities. This section shall define the individual “packages” for startup activities for the equipment or unit process systems.

5. Schedule of events for startup and other activities covered by the Plan.

   a. The schedule shall define dates for completing activities for equipment and unit process systems.

   b. The schedule shall be the Contractor’s best estimate of time sequence at the time of issuance.

   c. The Contractor shall submit monthly schedule updates to the Plan.

   d. The schedule shall follow the required sequencing as specified herein.

6. Sign-off sheets consisting of certification forms or completion reports required by the specifications shall be included in the Plan. Standard forms shall be developed by the Contactor for this purpose.

7. Reports, test results and other supporting data shall be collected by the Contractor for documentation of the specific details leading to the certification or completion.

B. Following shall be the sequence for completing functional completion testing, and subsequent startup, commissioning and performance testing activities required by the Plan.

1. Controls

2. High Service Pumps

C. Any variation in the startup sequence deemed necessary by the Contractor shall be reviewed by the Owner prior to changing the sequencing.

D. Prior to Functional Completion Testing the Contractor shall have performed the following preliminary matters.

1. Conduct (or have previously conducted, whichever is appropriate) all field inspections as defined in the individual sections of the Specifications, installation checks, hydrostatic tests, performance tests, and perform any corrections required.

2. Demonstrate that individual components of the completed work have been properly installed and operate in accordance with the Contract Documents, and that they are ready to be utilized for their intended purposes.

3. Remove all electrical jumpers, bypasses or other items connected to the equipment that are not intended to remain in the Facility and are not required by the Specifications.

4. Confirm that all electrical circuits are energized in the manual position, that valves and gates are set to their normal position and that flow through the completed work is unobstructed.

5. Install required temporary piping connections/facilities for supplying, circulating, and disposing of test water.

3.02 FUNCTIONAL COMPLETION TESTING

A. Provide 30 days written notice to the Owner for each functional completion test so that the Owner may witness the functional completion tests. The Owner may witness the performance of any or all functional completion testing, at their option.

B. Testing shall be conducted in accordance with the accepted Plan using applicable standard techniques reviewed by the Owner.

1. Local and remote instrumentation may be used to record test data where it is determined the devices have been calibrated and sufficient to obtain necessary data.

C. The Contractor shall develop standard data sheets to document Functional Completion Testing requirements have been met for all equipment and unit process systems included in the Plan.

1. As equipment testing is completed the appropriate data sheet shall be completed and signed by the responsible party and submitted to the Owner for review and acceptance.

2. Data values shall be stated in the engineering units noted in the equipment specifications.

D. A detailed Functional Completion Test plan shall be prepared and submitted to the Owner for review and comment.

1. The plan shall be prepared by the Contractor in conjunction with the equipment or subsystem supplier and shall become a part of the overall Plan.

E. In the event no reference to procedures is made, or no procedures for startup and commissioning are contained in a technical specification for the following test parameters, the following shall be the checkout requirements. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements for checkout testing.

1. Measurement of wearing ring clearances for all pumps requiring assembly, so equipped:

a. Take two readings taken opposed to each other by 90 degrees.

b. All measured clearances shall be within Supplier's specifications for new installations. Replace and recheck rings found to be out of round or out of specified tolerance.

2. Measurement of Impeller Bore for all pumps requiring assembly:

a. Take two readings opposed to each other by 90 degrees.

b. All measured clearances shall be within Supplier's specifications for new installations. Replace and recheck impellers found to be out of round or out of specified tolerance.

3. Measurement of shaft runout for all rotating equipment requiring assembly:

    a. Remove bearings from the shaft. Support shaft on pedestal rollers or in a lathe.

    b. Check each shoulder on the shaft.

    c. Take two readings for each shoulder, opposed to each other by 90 degrees.

    d. All measured clearances shall be within Supplier's specifications for new installations. Replace and recheck shafts found to be out of round or out of specified tolerance.

4. Vibration Measurements:

    a. Provide vibrational signature testing and documentation for each piece of direct drive or close coupled rotating equipment with a motor HP of 100 or above and a rated operating speed in excess of 1999 RPM.

    b. Unless specified otherwise, the current edition of the Hydraulic Institute Standard, "Acceptable Field Vibration Limits" shall be the standard for vibrational testing.

    c. Take all specified vibrational readings in three directions: vertical, horizontal, and axial.

    d. Provide vibrational measurements in the following engineering units:

        (1) Displacement in thousandths of an inch (mils), peak to peak.

        (2) Velocity in inches per second (ips), peak to peak.

        (3) Acceleration in feet per second per second (lg=32.3 ft/sec./sec.) zero to peak.

        (4) Spike energy in g-SE.

        (5) The vibrational readings shall be less than the device rotating frequency, and within the operating band specified by the Supplier.

        (6) Amplitude Allowable Maximums:

RPM	Amplitude inches peak to peak:
3,000 and above	0.001
1,500 - 2,999	0.002
1,000 - 1,499	0.0025
999 and below	0.003

5. Belt Drives:

    a. All belts shall ride within the sheave and not slip to the bottom of the groove(s).

    b. Belt tension shall be in accordance with Supplier's recommendations.

    c. Pulley alignment shall be within Supplier's recommendations.

6. Gear Drives and Reducers:

    a. Check gears for lash at no less than three points around the gear.

    b. Rotate gears a full 360 degrees while checking alignment.

7. Coupling/Shaft Alignment:

    a. Perform all final alignments and checks with a dial indicator or a laser device. Feeler gauges and straight edges are not acceptable.

    b. Eliminate soft foot conditions prior to aligning.

    c. When checking for final soft foot, any displacement in excess of 0.002" must be corrected.

    d. When checking for pipe strain, any displacement in excess of 0.002" requires piping realignment.

    e. Alignments will not be regarded as final until the grout is set and all piping has been attached. Demonstrate that alignment is not changed by attachment of piping.

    f. Shim the driving element, never the driven element.

g. Take bracket sag corrections into account when using a dial indicator. Bracket sag shall be determined on a rigid pipe.

h. Mount a dial indicator to the driven element so that it can be rotated. Rotate both elements while aligning.

i. When aligning three coupled elements, align gear reduction elements with the driven element first, then align the driver to the gear reduction element.

j. Check all four alignments, i.e., angular alignment in the vertical and horizontal planes, and parallel alignment in the vertical and horizontal planes.

k. The acceptable alignment accuracy for flexible couplings is +0.005 inches, or the Supplier's specifications, whichever is more stringent.

l. The dial indicator must be perpendicular to the alignment surface.

m. Number hold down nuts prior to tightening. Loosen in reverse order. Tighten in ascending order.

n. Use only clean, deburred shims. Clean the machine base and feet from rust or burrs prior to alignment.

8. Measurement of Noise (dB):

a. Eliminate noise sources generated by adjacent construction activity prior to testing.

b. Establish a background noise level prior to testing.

c. Perform noise level testing on each installed device as required by the technical specifications.

d. The maximum noise level exposure is 75 dBA over eight hours continuous for office, shop, and other areas where the Owner's personnel will be performing their assigned duties.

9. Hydrostatic Testing:

a. AWWA C600 standards latest edition are the standards for all hydrostatic testing.

b. Visually inspect all welds prior to testing, for cracks, undercut on surface greater than 1/32-inches deep, lack of fusion on surface, reinforcement greater than Table 127.4.2 located in ANSI B31.1 Power Piping, and incomplete penetration (when accessible). Repair or rework as directed by the Owner's Representative.

c. At no time during hydrostatic testing shall any part of the piping system be subjected to a stress greater than 90 percent of its yield strength at test temperature.

d. After 10 minutes of full hydrostatic test pressures, make an examination for leakage of all joints, connections, and all regions of high stress, such as around openings and thickness transition sections.

e. Unless otherwise specified, the minimum required hydrostatic test pressure shall be 1.5 times the design pressure as specified and as indicated.

f. Pressure holding time shall be 10 minutes plus the time required to inspect for leakage.

g. Maximum pressure shall not exceed the maximum rated pressure for any component in the system being tested.

10. Electrical Equipment:

a. The testing standards for electrical components are those contained in Division 26 and the pertinent technical specification(s).

F. When contracted, the Owner will furnish an authorized, competent representative of the equipment or unit process supplier to supervise and coordinate the Functional Completion Testing program.

1. Instrument readings and other test data shall be tabulated by the Contractor.

G. It is the intent that as a result of this phase of Section 01 78 25 that the following has been accomplished:

1. All structures and pipelines have been filled.

2. Operational adjustments desired by the Owner have been made.

3. All field devices are operational with control, indication, and alarm capability.

4. All electric valves can be operated.

5. Manufacturer's written certifications regarding equipment installation have been provided.

6. Manufacturer's training sessions have been conducted and video tape provided to the OWNER.

7. The system control and monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings.

8. Graphical display screens are functioning properly (by others)

9. Adjustments desired by the Owner have been made.

10. All functions of the automatic control system have been demonstrated and are fully operational.

11. Release/approvals have been received from JEA to place the Facility into operation.

H. Documentation Requirements:

1. Certificates are required for all Functional Completion Testing for equipment and unit process systems. Four copies of the completed certificates shall be supplied for review by the Owner. Contents of the certificate shall be at a minimum:

   a. Equipment Suppliers Review Comments and Approval Page. This page shall include Certification by the equipment or unit process systems suppliers that the equipment or unit process systems are properly installed and suitable for startup.

   b. Owner Review Comments and Approval Page.

   c. Test Descriptions/Procedures

      (1) Equipment or unit process systems tested.

      (2) Test dates.

      (3) Electrical Inspection and Tests

      (4) Test results.

(5) Any repairs or corrections required to obtain acceptable test results.

(6) Calibration sheet for instrumentation or devices used for testing but not part of plant installation.

(7) Copies of calibration records for plant installed instrumentation

d. Certify Mechanics and Installation. Inspection and certification to be conducted by equipment representative. Inspect and certify that each piece of equipment meets the following requirements:

(1) Not damaged in transportation or installation.

(2) Properly installed with no undue force imposed from piping or supports.

(3) Is properly lubricated.

(4) Motor rotation is correct.

(5) Free of overheating.

(6) Free of vibration.

(7) Free of noise.

(8) Functions without overloading.

(9) Piping and other connections are completed.

(10) No leaks at equipment connections (static pressure testing).

e. Inspection and certification to be conducted by Contractor.

f. Instrumentation and Control Inspection and Tests

g. Inspect and certify instrumentation and control circuits for the following:

(1) Loop checks have been completed for all signal and control circuits.

(2) All instruments have been calibrated.

(3) All instrumentation tubing has been pressure tested and any leaks repaired.

(4) Manual modes function as intended.

(5) Protective interlocks function as intended.

(6) Remote modes function as intended.

(7) Automatic modes function as intended.

h. Instrumentation tests include the following:

(1) Complete loop checks for all signals and controls. Control panel operates process properly in automatic mode.

(2) Tests certificates shall be submitted no later than 30 calendar days, after testing ends. The Owner's Representative and Owner shall have no more than 30 calendar days to complete a review and return with any exceptions noted.

3.03 STARTUP & COMMISSIONING:

A. Startup and commissioning shall be led by the Owner.

END OF SECTION

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SECTION 02 01 30

CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of hot-tap connections to existing buried ductile-iron and steel and PVC (cast-iron outside diameter) pipelines and line stopping (as required) and replacement of existing piping.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions, Section 01 33 00, and the following.

B. Submit manufacturer's catalog data for tapping sleeves. Show coatings.

PART 2 MATERIALS

2.01 TAPPING SLEEVES

A. Tapping sleeves shall comply with MSS SP-60, MSS SP-111, or AWWA C223, and MSS SP-113.

B. Tapping Sleeves shall be stainless steel, and from the current JEA Approved Materials (AW-203):

a. Cascade, CST-EX

b. Dresser Industries, Inc., 630

c. Ford Meter Box Company, FAST Series, FTSS

d. JCM Industries, Inc. 432, 439, 452 (14-inch and larger)

e. Power Seal, 3490, 3490 MJ

f. Romac Industries, SST

g. Smith Blair, 663 & 665

h. Mueller H304

C. Pressure rating shall be at least 200 psi for piping 12 inches and smaller and at least 150 psi for piping 14 through 24 inches.

2.02 COATING FOR TAPPING SLEEVES

A. Coat with fusion-bonded epoxy per Section 351 of the current JEA standards.

2.03 TAPPING GATE VALVES

A. Refer to Section 40 05 20 for gate valve specification requirements. Tapping valves shall be one of the following manufacturers/model in accordance with JEA's Current Approved Materials listed in AW-302.

   a. American Flow Control

   b. AVK (S/S Stem Only), 25/30081

   c. Clow Valve,F-6114,2638

   d. Kennedy Valve Company, 950-X

   e. M&H Valve, 4751

   f. Mueller, T-2360, T-2361

   g. U.S. Pipe, 5860

   h. Mueller-Aqua Grip, A-2361-76

   i. American – RD

2.04 CONNECTIONS TO EXISTING STEEL PIPES

A. Provide a fabricated steel collar with nozzle. Minimum thickness of collar plate and nozzle shell shall be 3/8 inch. Width of collar from the inside surface of the outlet to the outside edge of the collar shall be one-third to one-half of the diameter of the outlet. Collar may be oval or rectangular with rounded corners. An entire wrapper plate may be substituted for the collar. Steel material shall have a minimum yield stress of 30,000 psi.

PART 3 EXECUTION

3.01 VERIFICATION OF PIPE OUTSIDE DIAMETER PRIOR TO INSTALLATION

A. Excavate the points of connection prior to submittal of shop drawings. Verify outside diameter prior to ordering materials.

3.02 WRAPPING OR COATING TAPPING SLEEVES

A. After installation, wrap the entire sleeve and tapping valve with polyethylene sheet wrap.

END OF SECTION

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SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

Selective demolition of building elements for alteration purposes.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

2.01 SCOPE

Remove portions of existing buildings as indicated within the construction documents.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Obtain required permits.
2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
3. Provide, erect, and maintain temporary barriers and security devices.
4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
5. Do not close or obstruct roadways or sidewalks without permit.
6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

B. Protect existing structures and other elements that are not to be removed.

1. Provide bracing and shoring.

2. Prevent movement or settlement of adjacent structures.

3. Stop work immediately if adjacent structures appear to be in danger.

2.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

1. Verify that construction and utility arrangements are as indicated.

2. Report discrepancies to Architect before disturbing existing installation.

3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.

1. Remove items indicated on drawings.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and wall assemblies): Remove existing systems and equipment as indicated.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.

1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

2.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 03 11 00

CONCRETE FORMWORK

PART 1 GENERAL

1.01 REFERENCE:

A. General Provisions of the Contract, including General, Special and Supplementary Conditions and Division One General Requirements, apply to work specified in this Section.

1. 03 21 00 - Concrete Reinforcement
2. 03 30 00 - Cast-In-Place Concrete

1.02 WORK INCLUDES:

A. All formwork for concrete as described in this section, indicated on the drawings or required by other sections of these specifications. Openings for other affected work. Form accessories and stripping forms.

1.03 QUALITY ASSURANCE:

A. Codes and Standards

1. Formwork shall comply with the provisions of ACI 347 "Recommended Practice for Concrete Formwork".
2. ACI "Formwork for Concrete" and Specifications for Structural Concrete for Buildings.
3. PSI - "Construction and Industrial Plywood".

B. The Contractor is solely responsible for the design, construction and performance of the formwork. The engineers examination of formwork plans and shoring operations shall in no way relieve the contractor of this responsibility.

1.04 SUBMITTALS:

A. Submit to the Engineer shop drawings prepared and designed by an engineer registered in the state of Florida, for record purposes showing layout of shoring, sections and unusual details in accordance with the General Conditions of the

Contract for construction. Submit sufficient information for full description of capacity.

PART 2 PRODUCTS

2.01 MATERIALS:

A. Forms

1. Wood

a. For concrete below grade, use standard grade or better boards or planks; or use 3/4" minimum thickness exterior type plywood, Grade B/B, Class I, PS-1.

b. For exposed concrete surfaces use 3/4" minimum thickness exterior type plywood, Grade B/B, Class I, sanded both sides, PS-1.

2. Steel

a. Steel forms shall be of such thickness that they shall remain true to shape. Metal forms, which do not present a smooth surface or do not properly align shall not be used.

B. Form Oil

1. The inside of the forms shall be coated with a non-staining form oil, such as:

a. Magic-Kote by Symons Manufacturing Company, Des Plaines, Illinois;

b. Form-coat by Concrete Service Company, Philadelphia, Pennsylvania.

c. Eucoslip by Euclid Chemical Company.

C. Form Ties

1. Form ties shall be snap-in form tie with a 1 inch minimum break off depth from the face of the concrete.

2. Ties shall be removed after forms are removed and holes shall then be filled with mortar that matches the adjacent surfaces.

3. Provide stainless steel form ties for all exterior surfaces exposed to view.

4. Approved Manufacturers

a. Dayton "Sure-Grip"

b. Hechman "Snapties"

c. Richmond "Snap-Tys"

D. Anchors

1. Zinc-coated dovetail slots (oriented vertically) shall be located at 3 feet - 0 inches on center horizontally wherever concrete surfaces adjoin masonry. Where concrete masonry (CMU) abuts columns, provide dovetail slot at centerline of adjoining CMU.

2. Approved Manufacturers

a. Hechman Number 100 Standard, 24 gauge

b. Hohman & Barnard, Inc., Number 305

c. Wire Products Company, Number F-17

d. DAS-STD by Gateway Building Products

E. Vapor Barrier: 0.006-inch thick, natural Visqueen polyethylene film, as manufactured by the Visking Company or equal.

PART 3 EXECUTION

3.01 GENERAL:

A. Forms, bracing, and supports shall be designed and constructed to withstand the pressure of freshly placed concrete. Temperatures of the concrete at time of placing, effect of vibration, speed of placement, the height of plastic concrete and similar factors shall be considered in the design. Concrete surfaces that are to be exposed shall be free of misalignment, unsightly bulges, offsets or ledges.

B. Forms shall conform to the shape, lines, grades and dimensions of the concrete as called for on the drawings. Joints in forms shall be horizontal and vertical and shall be tightly fitted to prevent leakage of mortar. All vertical surfaces shall be formed.

C. Removable sections shall be provided at sufficient intervals at the base of walls and columns to allow cleaning and inspection before concrete is placed. All open joints,

holes or other blemishes shall be filled to provide a blemish free surface.

D. Forms for concrete floor slabs shall have sufficient strength and stiffness to prevent sagging or deflection while subjected to the usual construction loads. Walking on forms will not be permitted. Planks (2 in. thick) shall be distributed over the forms to prevent abuse. Wheeling of concrete or other materials directly over the forms will not be permitted. Runways above the top of the finished concrete shall be required throughout the construction period. Runways shall not rest on the reinforcing steel.

E. Embedded structural steel shapes meant to provide support for other structural elements shall be bolted to the formwork to maintain accurate positioning. Wiring or nailing will not be permitted.

F. 3/4 inch by 3/4" chamfer strips shall be placed in the corners of forms to produce beveled edges on all permanently exposed surfaces. Corners, which abut masonry walls, shall not be chamfered.

G. Forms shall be checked just prior to placing concrete and tightened as required to produce flush surfaces.

H. Provisions shall be made for chases, offsets, openings, depressions, curbs and bulkheads.

I. Camber formwork to compensate for anticipated deflections in the formwork due to weight of forms and wet concrete, and/or any additional camber as shown on the drawings.

J. Floors have not been designed to carry the construction loads of the floor above. Contractor must design and furnish necessary shoring and reshoring to support the loads.

K. The shores and supports for the formwork shall have ample strength to support all applied loads without settlement. Provide positive means of adjustment (wedges or jacks) for shores to take up any settlement during placement.

L. Sills, if any, shall rest on solid ground, free from frost. Studs, walls, and bracing shall be dimension stock of sizes as required by form design. Dimensions of centering, bracing, etc. shall be in accordance with "ACI Recommended Practices for Concrete Formwork" (ACI 347).

M. Sleeves, Reglets, Inserts and Conduits: After forms are erected and before

reinforcement is placed, all sleeves, reglets and inserts for mechanical trades must be set in place by the trade involved. Other sleeves, anchors, inserts, anchor bolts, specialties and similar items embedded in the concrete shall be furnished, accurately located as shown and set by the Contractor. In general, electric conduits shall be placed within the middle one-third of the thickness of the concrete in which it is embedded.

N. Before placing reinforcement or concrete the surface of the form shall be coated with approved non-staining form oil to prevent bond with the concrete surface.

O. Reinforcements shall be adjusted to fit the sleeves, inserts, and openings, using additional bars where required around openings.

3.02 BULKHEADS:

A. Place bulkheads where end of days work requires a joint in a wall, beam or slab. Reinforcing steel shall extend through the bulkhead. All joints shall be keyed for 2 of the member thickness unless directed otherwise by the Architect/Engineer. Location of bulkhead must be approved by the Architect/Engineer.

3.03 REMOVAL OF FORMS:

A. Forms shall not be removed from concrete surfaces until the following minimum requirements are met.

1. Formwork for concrete slabs and beams shall remain in place for a minimum of 48 hours, and until the concrete has achieved 75% of its design strength. Strength shall be determined by tests on cylinders site-cured under the same conditions as the work in question.

2. Column and wall formwork can be removed in 48 hours provided curing compound is applied immediately. If Contractor elects not to provide curing compound, forms must remain in place 7 days minimum.

3.04 RESHORING:

A. When reshoring is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is under way, no live load shall be permitted on the new construction.

B. In no case during reshoring shall concrete in beam, slab, column or any other structural member be subjected to combined dead and construction loads in excess

of the loads permitted by the Architect/Engineer for the developed concrete strength at the time of reshoring. Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs. Reshores shall be tightened to carry their required loads without over stressing the construction. Reshores shall remain in place until tests representative of the concrete being supported have reached the specified strength or the strength specified in the contract documents for removal of reshores.

C. Floors supporting shores under newly placed concrete shall have their original supporting shores left in place or shall be reshored. The reshoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one half of the capacity of the shoring system above. The reshores shall be located directly under a shore position above unless other locations are acceptable.

3.05 REUSE OF FORMS:

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

B. When forms are intended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, unless as acceptable to Architect/Engineer.

3.06 VAPOR BARRIER:

A. Before laying of sheet, subgrade must be smoothed eliminating any protrusions that may cause damage or rupturing of film.

B. Use widest practical widths; lapping where required shall be a Z-lock not less than 6 inches wide with top lap placed in the direction of the spreading of the concrete and underneath the reinforcing mesh prior to pouring.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 REFERENCE:

A. General Provisions of the Contract, including General, Special and Supplementary Conditions and Division One General Requirements, apply to work specified in this Section.

1. 03 11 00 - Concrete Formwork
2. 03 30 00 - Cast-In-Place Concrete
3. 03 41 40 - Precast Prestressed Concrete

1.02 WORK INCLUDES:

A. Provide concrete, concrete masonry unit and precast concrete reinforcement as shown on the drawings, required by these specifications or necessary for proper completion of the work.

1.03 SUBMITTALS:

A. Shop drawings showing all bar sizes, supports, fabrication dimensions and location for placing of the reinforcing in accordance with the General Conditions of the Contractor for construction shall be submitted for approval. Approval shall be obtained prior to fabrication.

B. Comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, diagrams of bent bars, and arrangements of concrete reinforcement.

1.04 QUALITY ASSURANCE:

A. Codes and Standards: Comply with the provisions of the most recent edition of the following codes, specifications and standards, except as otherwise shown or specified.

1. ACI 301 - Guidelines for Structural Concrete for Building.

2. ACI 315 - Details and Detailing of Concrete Reinforcement.

3. ANSI/ASTM A83 - Cold Drawn Steel Wire for Concrete Reinforcement.

4. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

5. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

6. ANSI/AWS D1.4 - Structural Welding Code Reinforcing Steel.

7. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

8. ASTM A616 - Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.

9. ASTM A617 - Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

10. CRSI - Manual of Practice.

11. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.

12. CRSI 65 - Recommended Practice for Placing Bar Supports, Guidelines and Nomenclature.

13. No foreign steel shall be used.

PART 2 PRODUCTS

2.01 MATERIAL:

A. Reinforcing Bars shall be rolled from new billet steel, Grade 60 and deformed in accordance with ASTM A615, for bars numbers 3 to number 18 and shall be epoxy coated conforming to ASTM A776 81 for piles and grade beams only.

B. Welded wire fabric shall be ASTM A185, welded steel wire fabric. The yield strength of the steel wire shall not be less than 60,000 pounds per square inch and shall be epoxy coated conforming to ASTM A776 81.

C. Bar Supports and Spacers

1. For unexposed concrete, bar supports and spacers shall be manufactured of standard brights basic wire upturned legs.

2. For concrete which will be exposed to view from the underside upon completion of the structures, use plastic capped bar supports and spacers.

3. For slabs on grade, use bolsters with runners where base will not support chair legs.

4. Do not use wood, brick or other non-specified material.

D. Tie wire: Federal specifications QQ-W-461 Annealed Steel, 16 ga. minimum for use on epoxy coated steel reinforcement.

E. Welded electrodes: AWS A5.1, Low Hydrogen, E70 Series.

F. Welded Inserts: Provide wedge inserts for the support of brick ledger angles. Wedge inserts shall be placed at 4'-0" o.c. unless drawings indicate a more restrictive spacing. Provide the F-7 wedge insert and 3/4" diameter askew bolt, nut and washers as manufactured by Dayton Superior, 10101 C General Drive, Orlando, Florida, or equal.

Wedge inserts and 3/4" diameter bolts to be deemed equal shall submit test information documenting an ultimate capacity of at least 8,500 pounds when the shelf angle is loaded 2-1/4" from the face of concrete, with the bottom of the insert 1-1/2" clear from the beam bottom, for concrete strength of 4,000 psi.

PART 3 EXECUTION

3.01 GENERAL:

A. Cleaning and storage reinforcement: Steel reinforcement at the time concrete is placed shall be free from heavy rust, scale or other coating that will destroy or reduce the bond.

B. All reinforcing steel shall be stored in neat piles at the site clear of the ground in such a manner that all bars can be readily identified when required.

C. Excessive form oil on the reinforcing shall be removed by washing the reinforcing with kerosene. Exercise due care that no smoking or welding is permitted in the area of cleaning. Provide fire extinguisher at cleaning site.

D. Supports for reinforcing steel: All reinforcing steel shall be rigidly supported, accurately located and held in position by the use of proper reinforcing steel

supports, spacers and accessories before the concrete placement begins.

E. The legs of all reinforcing supports shall be bent to form a foot so that the side and not the end of leg rods bears on the form.

F. Metal reinforcement shall be protected by the thickness of the concrete indicated on the drawings. Where not otherwise shown, the concrete cover shall be not less than the following:

1. 3 inches for footings and other principal structural members poured directly against the ground.

2. 2 inches for bars larger than number 5, and 1-1/2 inches for number 5 bars and smaller where concrete will be exposed to the ground or weather after removal of forms.

3. 1-1/2 inches in all beams, girders and columns.

4. 3/4 inches for all slabs and walls not exposed to the ground or weather.

5. In any event, there shall be not less than 3/4" of concrete protection over all reinforcing bars.

G. Do not use bar supports or reinforcing as support for concrete runways or construction loads.

H. Placing tolerances: Clear distance to formed surfaces: +/- 1/4 inch. Minimum spacing between bars: -1/4 inch:

1. Top Bars in Slabs or Beams:

Members 8" or less in depth: +/- 1/4 inch

Members 8" to 24" in depth: +/- 1/4 inch

Members 24" or greater in depth: +/- 1/2 inch

2. Crosswire of Slabs or Beams: Spaced evenly within 2 inches.

3. Lengthwise of Member: +/- 2 inches

I. Bending details: Typical bending and placing diagrams are shown on the drawings. For parts not shown, bending details and lengths shall conform to the requirements of the ACI Building Code 318 and "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315.

J. Bends for stirrups and ties shall be made around a pin having the diameter no less than 1-1/2 inches for number 3, and 2 inches for number 4.

K. Bends for other bars shall be made around a pin having a diameter not less than six bar diameters for number 3 to number 6, 8 bar diameters for number 9, number 10 and number 11, 10 bar diameters for number 14 and number 18.

L. All bars shall be bent cold. Heating of bars will not be allowed.

3.02 SPECIAL REINFORCING REQUIREMENTS:

A. Where walls or other items are shown as built integrally with other section, but are placed as separate pours, key and dowels must be provided. Dowels shall be the same size and at the same spacing as reinforcing.

B. Main reinforcing bars shall not be spliced unless so noted on the drawings or approved by the Architect/Engineer.

C. Provide 6 X 6 - W1.4 X W1.4 electrically welded wire fabric, ASTM A-185 reinforcing in all concrete slabs on ground unless shown otherwise.

D. Provide corner bars of same size and spacing as main reinforcement at all intersections and corners.

E. Where openings occur in walls, or slabs, provide two number 5 bars at all sides and extending at least two feet beyond the corners and two number 5 bars at least three feet long diagonally across each re-entrant corner.

F. Unless permitted by an Inspector employed by the owner reinforcement shall not be bent after being embedded in hardened concrete.

3.03 INSPECTION OF REINFORCEMENT:

A. Reinforcing placement must be checked by an Inspector employed by the owner before any concrete is placed. Any corrections shall be made before concrete is placed.

B. Placement of reinforcing shall occur in such sequence that the Inspector has sufficient time to inspect the correctness of the reinforcing within the placement area and retains the right to require necessary revisions be made before concrete is placed.

C. The Contractor shall notify the Inspector at least 24 hours in advance of concrete

placement for a particular portion of the building.

D. Galvanized wire ties of double loop and tightly fastened to secure the proper spacing of rods and ties are required.

3.04 LAP SPLICING:

A. Welded wire fabric shall be overlapped wherever successive mats or rolls are continuous such that the overlap measured between outermost cross wires is not less than one wire spacing plus 2 inches.

B. Longitudinal (continuous) footing reinforcing: Class B.

C. Beam Reinforcing: Class B.

D. Column Reinforcing: Class B Offset lap splices.

E. Column/footing dowels: Class B

F. Masonry vertical reinforcing: Class B.

G. Splices not included above: Class B.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade.

C. Concrete foundation walls.

D. Joint devices associated with concrete work.

E. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing.

B. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

C. Section 31 3116 - Termite Control: Field-applied termiticide and mildewcide for concrete surfaces.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

C. ACI 301 - Specifications for Structural Concrete; 2016.

D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.

E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

F. ACI 305R - Guide to Hot Weather Concreting; 2010.

G. ACI 308R - Guide to External Curing of Concrete; 2016.

H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2017).

I. ACI 347R - Guide to Formwork for Concrete; 2014.

J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.

K. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2016.

L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2017.

M. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

N. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).

O. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.

P. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2017a.

Q. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.

R. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.

S. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011 (Reapproved 2017).

T. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

U. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems; 2014, with Editorial Revision (2017).

V. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.04 SUBMITTALS

A. Mix Design: Submit proposed concrete mix design.

1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.

2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

B. Samples: Submit samples of underslab vapor retarder to be used.

C. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

1. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.

2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.

3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).

1. Type: Per structural plans billet-steel bars.

2. Finish: Galvanized in accordance with ASTM A767/A767M, Class I, unless

otherwise indicated.

B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.

1. WWR Style: Refer to Structural Plans.

C. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.

2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Refer to Structural Plans for Portland type.

1. Acquire cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C33/C33M.

1. Acquire aggregates for entire project from same source.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Installation: Comply with ASTM E1643.

2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

3. Manufacturers:

a. Fortifiber Building Systems Group; Moistop Ultra 10: www.fortifiber.com/#sle.

b. ISI Building Products; Viper VaporCheck II 10-mil (Class A): www.isibp.com/#sle.

c. Poly-America; Husky Yellow Guard 10 mil Vapor Barrier:

www.yellowguard.com/#sle.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Grout: Comply with ASTM C1107/C1107M.

C. Termite-Resistant Barrier Sealant: Solvent-based; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

1. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.

2. Manufacturers:

a. Polyguard Barrier Systems, Inc, a division of Polyguard Products, Inc; TERM Sealant Barrier: www.polyguardbarriers.com/#sle.

2.05 BONDING AND JOINTING PRODUCTS

A. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

2.06 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Normal Weight Concrete:

1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.

2. Water-Cement Ratio: Maximum 40 percent by weight.

3. Maximum Aggregate Size: 5/8 inch.

2.07 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

B. Adding Water: If concrete arrives on-site with slump less than suitable for placement,

do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Prepare existing concrete surfaces to be repaired according to ICRI 310.2R, _____.

E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.

F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

A. Locate joints as indicated on the drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

1. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Surfaces Not in Contact with Forms:

1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.

2. Final Curing: Begin after initial curing but before surface is dry.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Owner/Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner/Architect for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.01 DESCRIPTION:

A. Work included: Provide finishes on cast-in-place concrete as called for on the Drawings, specified herein, and need-ed for a complete and proper installation.

B. Related work:

1. Section 03 30 00 - Cast-in-place concrete.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Except as may be modified herein or otherwise directed by the Architect, comply with ACI 301, "Specifications for Structural Concrete for Buildings."

1.03 SUBMITTALS:

A. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

3. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

PART 2 PRODUCTS

2.01 MATERIALS:

A. General:

1. Carefully study the Drawings and these Specifications, and determine the location, extent, and type of required concrete finishes.

2. As required for the Work, provide the following materials, or equals approved in advance by the Architect.

B. Concrete materials: Comply with pertinent provisions of Section 03 30 00, except as may be modified herein.

C. Liquid bonding agent: “Weld-Crete,” manufactured by the Larsen Products Corporation.

D. Curing and protection paper:

1. Approved products:

a. "Sisalkraft, Orange Label";

b. Equal products complying with ASTM C171.

2. Where concrete will be exposed and will be subjected to abrasion, such as floor slabs, use non-staining paper such as "Sisalkraft, Seekure 896," or equal paper faced with polyethylene film.

E. Liquid curing agents:

1. Where application of specified finish materials will be inhibited by use of curing agents, cure the surface by water only; do not use chemical cure.

2. For curing other areas, use "Hunt TLF" manufactured by Hunt Process Company, Inc.

F. Floor sealer: Acceptable products:

1. "Superkote Special Clear Sealer" manufactured by Ven-Chem Company, Inc., P.O. Box 3186, Santa Barbara, California 93105 (213) 342-1195.

2. "Supershield" manufactured by James Darcey Company, Inc., 19712 Merridy Street, Chatsworth, California 91311 (213) 349-3705.

G. Slip-resistant abrasive aggregate:

1. Provide aluminum oxide, 14/36 grading.

2. Acceptable manufacturers:

   a. Carborundum Company;

   b. Norton Company;

   c. L. M. Scofield Company.

2.02 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINISHING OF FORMED SURFACES

A. General:

1. After removal of forms, give the concrete surfaces one or more of the finishes specified below where so indicated on the Drawings.

2. Revise the finishes as needed to secure the approval of the Architect.

B. As-cast finish:

1. Rough form finish:

   a. Leave surfaces with the texture imparted by forms, except patch tie holes and defects.

   b. Remove fins exceeding 1/4" in height.

2. Smooth form finish:

   a. Coordinate as necessary to secure form construction using

smooth, hard, uniform surfaces, with number of seams kept to a practical minimum and in a uniform and orderly pattern.

b. Patch tie holes and defects.

c. Remove fins completely.

C. Rubbed finishes:

1. Provide these finishes only where specifically called for, and then only on a "smooth form finish" base as described above.

2. Smooth rubbed finish:

a. Produce on newly hardened concrete no later than the day following form removal.

b. Wet the surfaces, and rub with carborundum brick or other abrasive until uniform color and texture are produced.

c. Do not use a cement grout other than the cement paste drawn from the concrete itself by the rubbing process.

3. Grout cleaned finish:

a. Do not start cleaning operations until all contiguous surfaces to be cleaned are completed and accessible.

b. Do not permit cleaning as the work progresses.

c. Mix one part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having the consistency of thick paint.

d. Substitute white portland cement for part of the gray portland cement as required to produce a color matching the color of surrounding concrete, as determined by a trial patch.

e. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout, and apply the grout uniformly with brushes or spray gun.

f. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes.

g. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, sack, or other means.

h. After the surface whites from drying (about 30 minutes at normal temperatures), rub vigorously with clean burlap.

i. Keep the surface damp for at least 36 hours after final rubbing.

D. Unspecified finish: If the finish of formed surfaces is not specifically called out elsewhere in the Contract Documents, provide the following finishes as applicable.

1. Rough form finish:

a. For all concrete surfaces not exposed to public view.

2. Smooth form finish:

a. For all concrete surfaces exposed to public view.

3.03 FINISHING SLABS

A. Definition of finishing tolerances:

1. "Class A": True plane within 1/8" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.

2. "Class B": True plane within 1/4" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.

3. "Class C": True plane within 1/4" in two feet as determined by a two foot straightedge placed anywhere on the slab in any direction.

B. Scratched finish: After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, roughen the surface with stiff brushes or rakes before the final set.

C. Floated finish:

1. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further until ready for floating.

2. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.

3. During or after the first floating, check the planeness of the surface with a

ten-foot straightedge applied at not less than two different angles.

4. Cut down high spots and fill low spots, and produce a surface with a Class B tolerance throughout.

5. Refloat the slab immediately to a uniform sandy texture.

D. Troweled finish:

1. Provide a floated finish as described above, followed by a power troweling and then a hand troweling.

a. Produce an initial surface which is relatively free from defects, but which still may show some trowel marks.

b. Provide hand troweling when a ringing sound is produced as the trowel is moved over the surface.

c. Thoroughly consolidate the surface by hand troweling.

2. Provide a finished surface essentially free from trowel marks, uniform in texture and appearance, and in a plane of Class A tolerance.

a. For concrete on metal deck, Class B plane tolerance is acceptable.

b. On surfaces intended to support floor coverings, use grinding or other means as necessary and remove all defects of such magnitude as would show through the floor covering.

E. Broom finish:

1. Provide a floated finish as described above.

2. While the surface is still plastic, provide a textured finish by drawing a fiber bristle broom uniformly over the surface.

3. Unless otherwise directed by the Architect, provide the texturing in one direction only. Provide "light," "medium," or "coarse" texturing as directed by the Architect or otherwise called for on the Drawings,

4. Provide “light,” “medium,” or “coarse” texturing as directed by the Architect or otherwise called for on the Drawings.

F. Unspecified finish: If the finish of slab surfaces is not specifically called for elsewhere in the Contract Documents, provide the following finishes as applicable:

1. Scratched finish:

    a. For surfaces scheduled to receive bond-applied cementitious applications.

2. Floated finish:

    a. For surfaces intended to receive roofing.

3. Troweled finish:

    a. For floors intended as walking surfaces;

    b. Floors scheduled to receive floor coverings or waterproof membrane;

4. Broom finish:

    a. Exterior pedestrian ramps.

5. Non-slip finish:

    a. Platforms, steps, and landings;

    b. Exterior pedestrian ramps.

3.04 CURING AND PROTECTION

A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures, and mechanical injury.

B. Preservation of moisture:

1. Unless otherwise directed by the Architect, apply one of the following procedures to concrete not in contact with forms, immediately after completion of placement and finishing.

    a. Ponding or continuous sprinkling;

    b. Application of absorptive mats or fabric kept continuously wet;

    c. Application of sand kept continuously wet;

    d. Continuous application of steam (not exceeding 150 degrees F) or mist spray;

    e. Application of waterproof sheet materials specified in Part 2 of this Section;

f. Application of other moisture-retaining covering as approved by the Architect;

g. Application of the curing agent specified in Part 2 of this Section or elsewhere in the Contract Documents.

2. Where forms are exposed to the sun, minimize moisture loss by keeping the forms wet until they can be removed safely.

3. Cure concrete by preserving moisture as specified above for at least seven days.

C. Temperature, wind, and humidity:

1. Cold weather:

a. When the mean daily temperature outdoors is less than 40 degrees F, maintain the temperature of the concrete between 50 degrees F and 70 degrees F for the required curing Period.

b. When necessary, provide proper and adequate heating system capable of maintaining the required heat without injury due to concentration of heat.

c. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases, which contain carbon dioxide.

2. Hot weather: When necessary, provide wind breaks, fog spraying, shading, sprinkling, ponding, or wet covering with a light colored material, applying as quickly as concrete hardening and finishing operations will allow.

3. Rate of temperature change: Keep the temperature of the air immediately adjacent to the concrete during and immediately following the curing period as uniform as possible and not exceeding a change of 5 degrees F in any one hour period, or 50 degrees F in any 24 hour period.

D. Protection from mechanical injury:

1. During the curing period, protect the concrete from damaging mechanical disturbances such as heavy shock, load stresses, and excessive vibration.

2. Protect finished concrete surfaces from damage from construction

equipment, materials, and methods, by application of curing procedures, and by rain and running water.

3. Do not load self-supporting structures in such a way as to overstress the concrete.

END OF SECTION

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SECTION 03 41 00

PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Beams, spandrels, girders, purlins.

B. Grout packing.

C. Connection and supporting devices.

1. Lintels and bond beams.

1.02 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A416/A416M - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 2017.

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

E. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.

F. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.

G. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

H. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.

I. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2017.

J. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2014.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

L. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.

M. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete; 2017.

N. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 1999.

O. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988.

P. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a pre-installation conference one week prior to commencing work of this section.

1. Discuss limitations, if any, on field cutting of openings.

1.04 SUBMITTALS

A. See Section 01-30-00 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.

C. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

1. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval.

D. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.

E. Designer's Qualification Statement.

F. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

B. Fabricator Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

C. Erector Qualifications: Company specializing in erecting products of this section with not less than 3 years experience.

D. Welder Qualifications: Qualified within previous 12 months in accordance with AWS D1.1/D1.1M and AWS D1.4/D1.4M.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

C. Protect members to prevent staining, chipping, or spalling of concrete.

D. Mark each member with date of production and final position in structure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Structural Precast Concrete:

1. Any manufacturer holding a PCI Group C Plant Certification for the types of products specified; see www.pci.org/find/manufacturer.

2.02 PRECAST UNITS

A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI 318 and applicable codes.

1. Design components to withstand dead loads and design loads in the configuration indicated on the drawings and as follows:

a. Exterior Vertical Assembly: ____ pounds per square foot positive and negative wind loads.

b. Maximum Allowable Deflection of Roof Assemblies: 1/180 of span, cambered to achieve slope to drain.

c. Maximum Allowable Deflection of Floor Assemblies: 1/240 of span, cambered to achieve flat surface under dead load.

2. Calculate structural properties of framing members in accordance with ACI 318.

3. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.

4. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

2.03 MATERIALS

A. Cement: Gray Portland type, conforming to ASTM C150/C150M, Type I.

B. Other Cementitious Materials:

1. Fly Ash or Natural Pozzolans: Comply with ASTM C618.

2. Ground Granulated Blast Furnace Slag: ASTM C989/C989M.

3. Silica Fume: Comply with ASTM C1240.

C. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.04 REINFORCEMENT

A. Tensioning Steel Tendons: ASTM A416/A416M, Grade 250 (1725); seven-wire stranded steel cable; low-relaxation type; full length without splices; weldless; uncoated.

B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi).

1. Plain billet-steel bars.

2. Galvanized in accordance with ASTM A767/A767M, Class I.

2.05 FABRICATION

A. Conform to fabrication procedures specified in PCI MNL-116.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Tension reinforcement tendons as required to achieve design load criteria.

E. Provide required openings with a dimension larger than 10 inches and embed accessories provided under other sections of the specifications, at indicated locations.

F. Exposed Ends at Stressing Tendons: Fill recess with non-shrink grout, trowel flush.

2.06 FABRICATION TOLERANCES

A. Conform to fabrication tolerances specified in PCI MNL-135, except as specifically amended below.

1. Variation From Nominal Dimension: Plus or minus 1/2 inch.
2. Variation From Intended Camber: Plus or minus 1/4 in per 10 ft, plus or minus 5/8 inch maximum.
3. Variation from End Squareness: Plus or minus 1/8 inch/12 in, maximum 3/8 in.
4. Maximum Misalignment of Anchors, Inserts, Openings: Plus or minus 1/8 inch.
5. Sweep: Plus or minus 1/4 inch.

2.07 FINISHES

A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

C. Finish members to PCI MNL-116 Commercial grade.

D. Plant Finish: Normal plant finish; surface may contain small surface holes caused by air bubbles, minor chips or spalling at edges or ends, without major discoloration.

E. Exposed-to-View Finish: Normal plant finish with fins and protrusions removed, ground edges and ends, flat face surfaces.

2.08 ACCESSORIES

A. Connecting and Supporting Devices; Anchors and Inserts: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts conforming to PCI MNL-123, and as follows:

1. Material: Carbon steel conforming to ASTM A36/A36M.

2. Finish: Prime painted, except where device surfaces will be in contact with concrete or will require field welding.

B. Specialty Adhesives:

1. Segmental Bridge Adhesive: ASTM C881/C881M, Type VI; two-component, 100 percent solids, non-sag, moisture-insensitive epoxy.

2. Products:

a. Dayton Superior Corporation; PRO-POXY Segmental Bridge Adhesive: www.daytonsuperior.com.

C. Grout: Non-shrink, non-metallic, minimum yield strength of 10,000 psi at 28 days.

1. Type: Epoxy.

D. Bearing Pads: High density plastic, Vulcanized elastomeric compound molded to size, Neoprene (Chloroprene), or Tetrafluoroethylene(TFE); Shore A Durometer ____; 1/8 inch thick, smooth both sides.

E. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.

F. Prime Paint: Zinc rich alkyd type.

2.09 SOURCE QUALITY CONTROL

A. Section 01-40-00 - Quality Requirements: Provide mix design for concrete.

B. Test samples in accordance with applicable ASTM standard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings.

3.02 PREPARATION

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.03 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. Maintain temporary bracing in place until final support is provided. Protect members from staining.

D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.

E. Adjust differential camber between precast members to tolerance before final attachment.

F. Install bearing pads.

G. Level differential elevation of adjoining horizontal members with grout to maximum slope of 1:12.

H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

I. Grout underside of column bearing plates.

J. Secure units in place. Perform welding in accordance with AWS D1.1/D1.1M.

3.04 TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-135 for erection tolerances, except as specifically amended below.

1. Plan Location from Building Grid Datum: Plus or minus 3/4 in.

2. Top Elevation from Building Elevation Datum at Plank Ends: Plus or minus 1/2 inch.

3. Maximum Jog in Alignment of Matching Ends: Plus or minus 1/2 inch.

4. Exposed Joint Dimension: Plus or minus 3/8 inch.

5. Differential Top Elevation As Erected: Plus or minus 3/8 inch.

6. Bearing Length in Span Direction: Plus or minus 3/8 inch.

7. Differential Bottom Elevation of Exposed Members: Plus or minus 3/16 inch.

C. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect. Execute modifications as directed.

3.05 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

B. Provide non-combustible shields during welding operations.

3.06 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

SECTION 04 05 13

MORTAR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for Masonry

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

A. Joint Reinforcement
B. Metal Accessories
C. Masonry Units
D. Flashing and Steel Metal

1.03 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete
B. Section 04 05 16 - Masonry Grout
C. Section 04 05 23 - Masonry Accessories
D. Section 04 20 00 - Reinforced Unit Masonry System
E. Section 07 92 00 - Joint Sealants

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM) latest edition:

1. ASTM C91 - Masonry Cement
2. ASTM C144 - Aggregate for Masonry Mortar
3. ASTM C150 - Portland Cement
4. ASTM C207 - Hydrated Lime for Masonry Purposes
5. ASTM C270 - Mortar for Unit Masonry
6. ASTM C387 - Packaged, Dry, Combined Materials for Mortar and Concrete
7. ASTM C595 - Blended Hydraulic Cements

8. ASTM C780 - Standard Test Method for Prognostication and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

9. ASTM C1142 - Extended Life Mortar for Unit Masonry

10. ASTM C1180 - Standard Terminology of Mortar and Grout for Unit Masonry

11. ASTM C1329 - Mortar Cement

1.05 SUBMITTALS

A. Submit data indicating specifications used for mortar.

B. Submit test reports for mortar materials indicating conformance to ASTM C270.

C. Submit test reports for field sampling and testing mortar in conformance to ASTM C780.

D. Samples: Submit two ribbons of mortar for conformance with color.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver and store manufactured products in original, unopened containers.

B. Store materials in a clean, dry location protected from dampness and freezing.

C. Store cementitious ingredients in weather-tight enclosures and protect against contamination and warehouse set.

D. Stockpile and handle aggregates to prevent contamination from foreign materials.

E. Store admixtures to prevent contamination of damage from excessive temperature changes.

F. Keep water clean and free from harmful materials.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Heat sand and/or mixing water when the air temperature is below 40° to provide mortar and grout temperatures between 40°F and 120°F.

B. Do not heat sand or water above 120°F.

PART 2 PRODUCTS

2.01 MORTAR MATERIALS

A. Cement:

1. Portland Cement: ASTM C150, Type I or II
2. Mortar Cement: ASTM C1329
3. Masonry Cement: ASTM C91

B. Hydrated Lime: ASTM C207

C. Sand: ASTM C144

D. Admixtures:

1. The use of admixtures shall not be permitted except as specified by the Architect/Engineer and as approved by the Building Official.
2. No air entraining admixtures or material containing air entraining admixtures may be used.
3. No antifreeze compounds shall be added to mortar.
4. No admixtures containing chlorides shall be added to mortar.

E. Water:

1. Water shall be clean, potable and free from deleterious quantities of acids, alkalis and organic materials.
2. Water shall come from a domestic supply.

F. Mortar Pigment:

1. Mortar pigment shall not exceed 10% of the weight of Portland cement.
2. Carbon black shall not exceed 2% of the weight of Portland cement.

2.02 MORTAR MIXES

Mortar: ASTM C270, Type M, S, N or O.

PART 3 EXECUTION

3.01 FIELD MIXING MORTAR

A. All cementitious materials and aggregate shall be mixed between 3 and 10

minutes in a mechanical mixer with the amount of water to produce a spreadable, workable consistency. Dry mixes for mortar which have been preblended in a factory shall be mixed at the jobsite until workable, but not to exceed 10 minutes.

B. Control batching procedure to ensure proper proportions by measuring material by volume.

C. The consistency of mortar and grout may be adjusted to the satisfaction of the mason by retempering with water. Mortar may be retempered once within 2½ hours after initial mixing to compensate for water lost due to initial evaporation. Retempering shall be done by adding water into a formed basin within the mortar and then working the mortar into the water. Mortar shall not be retempered by splashing water over the surface.

D. Discard all mortar which has begun to harden. Also discard mortar if more than 2½ hours old.

3.02 APPLICATION OF MORTAR

A. Ends of solid masonry units shall be buttered with sufficient mortar to fill head joints. Hollow unit masonry shall be mortared so that the head joint thickness is equal to the face shell thickness.

B. Mortar beds for solid units shall be slightly beveled towards the center of the wall so that the bed joints will be sufficiently filled when the masonry unit is brought into line. Furrowing of the joints is not permitted.

C. Closures shall be rocked into place with mortared head joints against two adjacent brick in place.

D. Corners and jambs may not be pounded into position to fit stretcher units.

E. Units which have been displaced after the mortar has begun to set shall be cleaned of all mortar and reset with fresh mortar.

F. Mortar fins and protrusions which protrude more than ½ inch into cells or spaces to be grouted are to be avoided.

G. Mortar Joints shall be tooled as directed in Division 4.

END OF SECTION

SECTION 04 05 16

MASONRY GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grout for Masonry

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

A. Reinforcing Steel

B. Metal Accessories

C. Masonry Units

D. Flashing and Steel Metal

1.03 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete

B. Section 04 05 13 - Mortar

C. Section 04 09 23 - Masonry Accessories

D. Section 04 20 00 - Reinforced Unit Masonry Systems

E. Section 07 90 00 - Joint Sealants

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM) latest edition:

1. ASTM C150 - Portland Cement
2. ASTM C207 - Hydrated Lime for Masonry Purposes
3. ASTM C387 - Packaged, Dry, Combined Materials for Mortar and Concrete
4. ASTM C404 - Aggregates for Masonry Grout
5. ASTM C476 - Grout for Masonry
6. ASTM C595 - Blended Hydraulic Cements

7. ASTM C1019 - Standard Method of Sampling and Testing Grout

1.05 SUBMITTALS

A. Submit test reports for grout materials including conformance to ASTM C476.

B. Submit test reports for field sampling and testing grout in conformance to ASTM C1019.

1.06 DELIVERY, STORAGE AND HANDLING

A. Grout may be plant-batched and shipped to project in ready mix trucks or grout may be mixed at project site.

B. Deliver and store manufactured products in original, unopened containers.

C. Store materials in a clean, dry location protected from dampness and freezing.

D. Store cementitious ingredients in weather-tight enclosures and protect against contamination and warehouse set.

E. Stockpile and handle aggregates to prevent contamination from foreign materials.

F. Store admixtures to prevent contamination of damage from excessive temperature changes.

G. Keep water clean and free from harmful materials.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Heat sand and/or mixing water when the air temperature is below 40°F to provide mortar and grout temperature between 40°F and 120°F when used.

B. Do not heat sand or water above 120°F.

PART 2 PRODUCTS

2.01 GROUT MATERIALS

A. Portland Cement: ASTM C150

B. Hydrated Lime: ASTM C207

C. Aggregate: ASTM C404

D. Admixtures:

1. The use of admixtures shall not be permitted except as specified by the Architect/Engineer and as approved by the Building Official.

2. An admixture shall be used in high lift grouting to counteract water loss and volume reduction.

E. Water:

1. Water shall be clean, potable and free from deleterious quantities of acids, alkalis and organic materials.

2. Water shall come from a domestic supply.

2.02 GROUT MIXES

Grout: ASTM C476

A. Fine Grout (1 part Portland cement; 2¼ to 3 parts sand)

B. Coarse Grout (1 part Portland cement; 2¼ to 3 parts sand; 1 to 2 parts gravel)

C. Slump: 8 to 11 inches

D. Minimum strength 2,000 psi

PART 3 EXECUTION

3.01 FIELD MIXING GROUT

A. All cementitious material and aggregate shall be mixed between 3 and 10 minutes in a mechanical mixer with the amount of water to produce a spreadable, workable consistency. Dry mixes for grout which have been preblended in a factory shall be mixed at the jobsite until workable, but not to exceed 10 minutes.

B. Control batching procedure to ensure proper proportions by measuring material by volume.

C. The consistency of grout may be adjusted to the satisfaction of the masonry by retempering with water.

D. Discard all grout which has begun to harden. Also discard grout which is more than 1½ hours old.

3.02 LOW LIFT GROUTING

A. Grout pours 12 inches and less:

1. If necessary, clean or roughen concrete foundation by sandblasting, chipping or other means to remove laitance.

2. Lay one course of masonry making sure no mortar extends into grout spaces.

3. Place all reinforcement which extends into grouted areas. Reinforcement shall be secured prior to grouting.

4. Grout to below one-half of the top unit height and consolidate by puddling to eliminate voids in the grout.

5. Lay an additional 12 inches of masonry units.

6. Grout each 12 inches as the units are laid. Hold the top of each grout pour approximately 1½ inches below the top of the wall. Provide at least ½ inch of grout cover above horizontal reinforcing steel.

7. At the completion of each wall, grout flush to the top of the units.

8. Remove all grout droppings as the work progresses.

B. Grout pours more than 12 inches and up to 5 feet.

1. Construct the masonry wall up to 5 feet above the foundation. Install all reinforcing steel, anchors and embedded items as masonry work progresses.

2. For two wythe walls, bond the wythes together with rectangular ties or joint reinforcing so that one cross wire secures approximately two square feet of wall.

3. For walls that are to be partially grouted, use expanded metal mesh or other material which will not interfere with bond to restrict the grout into only those cells which are to be grouted.

4. After the mortar joints have set, grout the wall to 1½ inches below the top of the wall. Where bond beams occur, stop grout pour a minimum of ½ inch below top of masonry.

5. Consolidate the grout using a mechanical vibrator and reconsolidate after the excess water is absorbed into the masonry units.

6. Continue to lay up masonry and reinforcing steel, up to 5 feet at a time. After the mortar has set, grout and consolidate.

7. At the completion of the wall, fill the grout space flush with the top of the units and consolidate.

3.03 HIGH LIFT GROUTING

A. Construct the masonry wall up to a maximum of 24 feet above the foundation. Provide cleanout openings at the base of the wall at all vertical reinforcing bars but at a spacing no more than 32 inches on centers for solid grouted walls or a maximum of 48 inches on centers for partially grouted walls.

B. Install horizontal reinforcing steel, anchors and embedded items as masonry work progresses. Vertical reinforcing steel may be placed after the wall is constructed provided it is supported every 200 bar diameters with wire positioners or other devices to hold it in place. All reinforcement must be in place prior to grouting.

C. For two wythe walls, bond the wythes with rectangular ties or joint reinforcing so that one cross wire secures approximately two square feet of wall.

D. Install vertical grout dams at a maximum horizontal spacing of 30 feet to control the horizontal flow of grout.

For walls that are to be partially grouted, use expanded metal lath mesh or other material which will not interfere with bond to restrict the grout into only those cells which are to be grouted.

E. After the mortar joints have set, remove protruding mortar fins which excessively constrict the grout space. Remove all such droppings and debris through the cleanouts at the base of the wall.

F. After the cleanouts have been inspected, seal and brace the cleanouts.

G. Grout the walls in six foot lifts. All cells and spaces containing reinforcing steel shall be solidly grouted for partially grouted walls. For solid grouted walls, all cells shall be grouted.

H. Consolidate the grout using a mechanical vibrator and reconsolidate after the excess water is absorbed into the masonry units.

I. Stop the grout 1½ inches below the top of the uppermost grouted unit if the grouting is to be stopped for more than one hour.

J. Continue to grout the wall in six foot lifts, consolidating and reconsolidating each lift.

K. Where additional masonry is to be laid above this point, stop the grout 1½ inches below the top of the masonry units. Otherwise, fill the grout space flush with the top of the units at the top of the wall and consolidate.

END OF SECTION

SECTION 04 05 23

MASONRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Masonry reinforcement and anchors.

B. Control and expansion joints.

1.02 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete

B. Section 04 05 13 - Mortar

C. Section 04 05 16 - Masonry Grout

D. Section 04 20 00 - Reinforced Unit Masonry Systems

E. Section 07 90 00 - Joint Sealants

1.03 REFERENCES

American Society for Testing and Materials (ASTM) latest edition:

A. ASTM A116 - Metallic Coated Steel Woven Wire Fence Fabric

B. ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware

C. ASTM A615 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

D. ASTM A951 - Steel Wire for Masonry Joint Reinforcement

1.04 SUBMITTALS

Submit shop drawings of the following items:

A. Reinforcement for masonry lintels, bond beams, etc.

B. Control and/or expansion joints.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcement bars for lintels, bond beams, pilasters and other masonry reinforcement shall conform to ASTM A615, Grade 60.

B. Joint reinforcement shall conform to ASTM A951 and hot dipped galvanized in accordance with ASTM A153. Provide prefabricated pieces for corners and intersections of walls. Reinforcement shall be truss type approximately 2 inches narrower than the nominal thickness of the wall or partition.

C. Reinforcement used in cavity walls shall have a drip between masonry wythes.

D. Wire mesh ties shall be 16 gage or larger diameter zinc-coated steel wire woven into ½-inch mesh and cut into strips 1-inch narrower than the width of walls in which they are used. Zinc-coating shall conform to ASTM A116, Class 2 or 3 coating.

2.02 RIGID STEEL ANCHORS

Rigid steel anchors shall be a minimum of 1" x 1/4" x 26" long with each end turned up not less than 2 inches. Anchors shall be zinc-coated conforming to ASTM A116, Class 2 or 3.

2.03 SEALS AND GASKETS FOR CONTROL AND EXPANSION JOINTS

Seals and gaskets for control and expansion joint shall be of closed cell natural or synthetic rubber. Provide seals and gaskets of indicated shapes and in locations as specified or indicated on Drawings. Seals and gaskets shall be resistant to oils and solvents and shall be flexible after being exposed to temperature of minus 40° F.

2.04 WIRE TIES

A. Wire ties shall be fabricated from 3/16-inch diameter zinc-coated steel wire conforming to ASTM A116, Class 2 or 3 coating. Ties shall be at least 4 inches wide and embedded 4 inches into backup material, unless otherwise indicated on the Drawings.

B. Ties used in cavity walls shall have a drip between masonry wythes.

PART 3 EXECUTION

3.01 JOINT REINFORCEMENT

A. Install horizontal continuous joint reinforcement in all unit masonry walls, back-ups, and partitions. Reinforcement shall start not more than 8 inches above the masonry supporting surface and end within the top full mortar joint, or as indicated on the Drawings, and shall be spaced at maximum 16-inch centers vertically.

B. Reinforcement shall be placed in the first three mortar joints above lintels and below openings. Extend the reinforcement at least 24 inches past jambs. In addition, provide wire ties alternating with reinforcement 16 inches on centers vertically and within 12 inches of opening jambs.

C. Reinforcement shall be continuous but shall not pass through vertical masonry expansion or control joints unless otherwise shown on the Drawings. Side rods of horizontal joint reinforcement shall be lapped at least 6 inches at splices.

D. Joint reinforcement shall be placed in a manner to assure 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.

E. At intersections bond each course with wire mesh ties or prefabricated joint reinforcement spaced not to exceed 16 inches vertically.

3.02 VERTICAL REINFORCEMENT

Install vertical reinforcement bars in the hollow cores of masonry units where indicated on the Drawings. Fill all cells containing reinforcement with masonry grout or Class A concrete for the full height of the reinforcement.

3.03 ANCHORAGE

A. All masonry unit partitions that abut exterior walls, except when control joints occur at such locations, shall be anchored once every 16 inches vertically with rigid steel anchors. Anchors shall extend at least 4 inches into wall and not less than 18 inches into partition.

B. When intersecting walls are carried up separately, the vertical joint shall be regularly toothed or bonded with 8-inch offsets and the joints provided with rigid steel anchors spaced not more than 24 inches apart vertically.

C. At intersecting partitions, the vertical joint shall be tied with wire mesh ties spaced at 16 inches vertically.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Common brick.

C. Mortar and grout.

D. Reinforcement and anchorage.

E. Flashings.

F. Lintels.

G. Accessories.

1.02 RELATED REQUIREMENTS

Section 04 0511 - Mortar and Masonry Grout.

A. Section 07 1113 - Bituminous Dampproofing: Dampproofing masonry surfaces.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016.

C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.

D. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.

E. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.

F. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2017.

G. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.

H. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.

J. ASTM C476 - Standard Specification for Grout for Masonry; 2018.

K. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

L. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.

M. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 by 8 inches and 16 by 6 inches and nominal depths as indicated on the drawings for specific locations.

2. Load-Bearing Units: ASTM C90, normal weight.

   a. Hollow block, as indicated.

3. Non-Loadbearing Units: ASTM C129.

a. Hollow block, as indicated.

2.02 BRICK UNITS

A. Manufacturers: (Match color, texture and style of existing brick)

1. Belden Brick; Belcrest: www.beldenbrick.com.
2. Endicott Clay Products Co: www.endicott.com.
3. General Shale Brick : www.generalshale.com.
4. Meridian Brick LLC; www.meridianbrick.com/#sle.

2.03 MORTAR AND GROUT MATERIALS

A. Mortar and Grout: As specified in Section 04 05 11. (Match color of existing grout)

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

1. Not more than 0.60 percent alkali.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

2.04 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:

1. Blok-Lok Limited; www.blok-lok.com.
2. Hohmann & Barnard, Inc; X-Seal Anchor: www.h-b.com/#sle.
3. WIRE-BOND; www.wirebond.com/#sle.

B. Residential Wall Ties: Corrugated formed sheet metal, 7/8 inch wide by 0.05 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to extend at least 1-1/2 inches into the veneer with at least 5/8 inch of mortar coverage from masonry face.

C. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A

153/A 153M, Class B.

1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
3. Vertical adjustment: Not less than 3-1/2 inches.

2.05 FLASHINGS

A. Membrane Asphaltic Flashing Materials:

1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 30 mils (.03 inch) minimum total thickness; 8 mil cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.

a. Manufacturers:

1) Advanced Building Products, Inc; Strip-N-Flash: www.advancedbuildingproducts.com/#sle

2.06 ACCESSORIES

A. Weeps:

1. Type: String weeps at 32" O.C..

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:

1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Flush.

D. Brick Units:

1. Bond: Match Existing.
2. Coursing: Three units and three mortar joints to equal Match Existing inches.
3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 32 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.07 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend plastic, laminated, EPDM, and flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

3.11 LINTELS

A. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

1. Openings over 60 inches: Reinforce openings as detailed.

3.12 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.13 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation from Alignment of Columns: 1/4 inch.

C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.14 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 PARGING

A. Dampen masonry walls prior to parging.

B. Scarify each parging coat to ensure full bond to subsequent coat.

C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch.

D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot.

3.16 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.17 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 05 20

METAL MATERIALS, METHODS AND FASTENING

PART 1 GENERAL

1.01 DESCRIPTION

Work Specified Herein and Elsewhere

A. This Section includes the basic materials and methods required for the work of Division 5, Metals.

B. Related Work Specified Elsewhere - Painting - Section 09 90 00

PART 2 PRODUCTS

2.01 STEEL

A. Steel shall comply with ASTM A36, unless otherwise specified.

B. Structural steel tubing shall comply with ASTM A500, Grade B or ASTM A501.

C. Steel pipe shall comply with ASTM A53, Grade B.

2.02 STAINLESS STEEL

Stainless steel shall comply with ASTM A167, type 316.

2.03 ALUMINUM

A. Aluminum for structural and rolled shapes shall be Aluminum Association alloy 6061-T6.

B. Aluminum for extruded shapes shall be Aluminum Association alloy 6063-T6.

C. Aluminum for pipe shall be Aluminum Association alloy 6063-T6.

D. Aluminum for castings shall be Aluminum Association alloy F-514, or approved equal.

2.04 CAST IRON

A. Gray iron for castings shall comply with ASTM A48, Class 30 or approved equal.

B. Malleable iron castings shall be made of high grade white iron, fully annealed, of uniform ductile strength and shall comply with ASTM A197.

2.05 BOLTS

A. High strength bolts shall comply with ASTM A325 with suitable nuts and washers, complying with ASTM A354, Grade BC.

B. Anchor bolts and connection bolts for steel assemblies shall comply with ASTM A307.

C. Anchor bolts and connection bolts for aluminum shall be stainless steel.

2.06 WELDING ELECTRODES

Filler metal for welding shall comply with AWS D1.1, Structural Welding Code.

2.07 GROUT

Grout for bedding and grouting structural steel shall be non-shrink grout as specified in Section 03300.

2.08 FABRICATION

A. General

1. Fabricate all metal parts to comply with the design indicated on the Drawings. Make field measurements and prepare templates as required to ensure proper fit. Assemblies shall be fitted together in the shop and delivered to the site complete and ready for installation.

2. Form metal shapes with sharp lines and angles, and finish with smooth surfaces. Shearings and punchings shall be clean and true. In general, holes for bolts shall be drilled or reamed 1/16_inch larger than the diameter of the bolt. Holes for anchor bolts shall be 1-1/3 times the anchor bolt diameter.

3. Metal thicknesses, assembly details, and supports shall provide ample strength and stiffness. Joints shall be designed to prevent trapping of moisture.

B. Shop Coatings

1. Prepare and shop prime ferrous metal in compliance with Section 09900. Do not shop prime stainless steel, aluminum, galvanized or plated metals, bronze, or machined bearing surfaces.

2. Anchors, sleeves, and metal parts built into masonry or concrete shall be galvanized or coated with a bituminous paint.

3. Castings for exterior exposure shall be cleaned and coated with coal-tar-pitch varnish.

4. Hot-dip galvanizing for products fabricated from steel shapes, plates, bars, and strips shall comply with ASTM A123. Hot-dip galvanizing for assembled steel products shall comply with ASTM A386. Except for bolts and nuts for field assembly, galvanize all subassemblies immediately after fabrication. Hardware shall be galvanized in compliance with ASTM A153.

5. Aluminum in direct contact with dissimilar metals, concrete, or masonry shall be coated with a heavy-bodied bituminous paint or covered with non-absorptive insulating tape or gasket.

C. Fasteners and Connections

1. Provide fastening devices as required and in compliance with the Drawings and shop drawings. Provide welded shop connections or concealed fastenings wherever practicable.

2. Power-driven fasteners shall be of the types and sizes recommended by the manufacturer for the particular application. Power-driven fasteners that will be exposed to view shall be set through a steel finishing disc. When set in concrete or masonry, the minimum penetration of power-driven fasteners shall be six times the diameter of the shank.

3. Structural joints made using high strength bolts, hardened washers, and nuts tightened to a high bolt tension shall comply with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts", issued by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

4. Welded joints shall comply with AWS D1.1, Structural Welding Code, and AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings". All welds shall be made by operators who have been previously qualified as prescribed by AWS B3.0, Welding Procedure and Performance Qualification. All welds exposed to view shall be dressed smooth.

5. Anchor holes in concrete or masonry for grouted bolts shall be a minimum of 1-1/2 times the bolt shank diameter. Anchor holes in concrete and masonry for expansion type anchor bolts shall comply with the bolt manufacturer's recommendations.

6. Screw heads shall be countersunk. Bolt threads shall be nicked to prevent nut loosening.

2.09 TEMPLATES, LEVELING PLATES, AND APPURTENANCES

Provide all templates, leveling plates, and appurtenances required for the installation of metal work.

END OF SECTION

SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Free-standing railings at steps.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.

B. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.

C. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

B. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.

C. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.

D. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2010e1.

E. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications; 2013, with Editorial Revision (2014).

F. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013, with Editorial Revision.

G. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

1.04 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

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

2. Include the design engineer's seal and signature on each sheet of shop drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Handrails and Railings:

1. Alumi-Guard;____: www.alumi-guard.com/sle.

2. C.R. Laurence Company, Inc; CRL Welded Post Railing Systems (WRS): www.crl-arch.com/sle.

3. Superior Aluminum Products, Inc; Series 500: www.superioraluminum.com/#sle.

2.02 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

G. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.03 ALUMINUM MATERIALS

A. Aluminum Pipe: Schedule 40; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

B. Aluminum Tube: Minimum wall thickness of 0.127 inch; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

C. Solid Bars and Flats: ASTM B211 (ASTM B211M).

D. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.

E. Welding Fittings: No exposed fasteners; cast aluminum.

F. Straight Splice Connectors: Concealed spigot; cast aluminum.

G. Exposed Fasteners: No exposed bolts or screws.

2.04 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by intermittent welds

and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.

2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.

3. 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.

2.05 ALUMINUM FINISHES

A. Color: To be selected by Architect from manufacturer's standard line.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 53 05

GRATINGS AND FLOOR PLATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed metal floor gratings.

B. Flat surface floor and stair tread plating.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

D. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.

F. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

G. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.

H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

J. NAAMM MBG 531 - Metal Bar Grating Manual; 2017.

K. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

L. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).

1.03 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide span and deflection tables.

C. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ross Technology Corporation: www.rosstechnology.com/#sle.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Design Live (Pedestrian) Load: Uniform load of 100 lb/sq ft minimum; concentrated load of 300 lbs.

B. Maximum Spacing Between Bars: 1 inch.

2.03 MATERIALS

A. Steel Floor Plate: ASTM A786/A786M; manufacturer's standard pattern.

B. Sheet Steel for Die Stamping: ASTM A1011/A1011M Designation CS hot-rolled sheet.

C. Steel For Welding or Riveting: ASTM A36/A36M, unfinished, of shapes indicated.

D. Steel Framing: ASTM A36/A36M shapes, unfinished.

E. Cross Bars: ASTM B211 (ASTM B211M) solid bars.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.04 ACCESSORIES

A. Fasteners and Saddle Clips: Galvanized steel:

2.05 FABRICATION

A. Grating Type: NAAMM MBG 531, Pressure Locked Type.

B. Mechanically clinch joints of intersecting metal sections.

C. Fabricate support framing for openings.

D. Top Surface: Serrated.

2.06 FINISHES

A. Prepare surfaces to be primed in accordance with SSPC-SP 2.

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

C. Do not prime surfaces in direct contact with concrete or where field welding is required.

D. Prime paint items with one coat.

E. Galvanizing for Steel Shapes: ASTM A123/A123M.

F. Galvanizing for Steel Hardware: ASTM A153/A153M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes and dimensional tolerances are acceptable.

B. Verify that supports are correctly positioned.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Place frames in correct position, plumb and level.

C. Mechanically cut galvanized finish surfaces. Do not flame cut.

D. Anchor by welding.

E. Set perimeter closure flush with top of grating and surrounding construction.

F. Secure to prevent movement.

3.03 TOLERANCES

A. Comply with NAAMM MBG 531.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Preservative treated wood materials.

B. Miscellaneous framing and sheathing.

C. Communications and electrical room mounting boards.

D. Concealed wood blocking, nailers, and supports.

E. Miscellaneous wood nailers, furring, and grounds.

1.03 REFERENCES

A. AFPA T10 - Wood Frame Construction Manual; American Forest and Paper Association; 2001.

B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.

C. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2007.

D. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

1.04 SUBMITTALS

A. Product Data: Provide technical data on wood preservative materials and application instructions.

B. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.

B. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

1.06 DELIVERY, STORAGE AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 EXPOSED DIMENSION LUMBER

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

2.03 EXPOSED BOARDS

A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.

B. Moisture Content: Kiln-dry (15 percent maximum).

C. Surfacing: S4S.

D. Species: Southern Pine.

E. Grade: No. 2, 2 Common, or Construction.

2.04 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:

1. Manufacturers:

a. Chemical Specialties, Inc: www.treatedwood.com.

b. Substitutions: See Section 01600 - Product Requirements.

C. Preservative Pressure Treatment of Lumber Above Grade: AWPA Use Category UC3B, Commodity Specification A (Treatment C2) using waterborne preservative to 0.25 lb/cu ft retention.

1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION – GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.

3.04 BLOCKING, NAILERS AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

D. Specifically, provide the following non-structural framing and blocking:

1. Joints of rigid wall coverings that occur between studs.

3.05 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01732.

1. Comply with applicable regulations.

2. Do not burn scrap on project site.

3. Do not burn scraps that have been pressure treated.

4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

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SECTION 07 11 13

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

1.02 REFERENCE STANDARDS

A. ASTM D449/D449M - Standard Specification for Asphalt Used in Dampproofing and Waterproofing; 2003 (Reapproved 2014).

B. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007, with Editorial Revision (2012).

C. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide properties of primer, bitumen, and mastics.

1.04 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Henry 785 Asphalt Emulsion Damp Proofing - trowel grade; us.henry.com/waterproofing/dampproofing/.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied, spray-grade; asphalt base, volatile petroleum solvents, and other content, suitable for application by spray, brush, roller, or squeegee; asbestos-free; suitable for application on vertical

and horizontal surfaces.

1. Composition: ASTM D4479/D4479M Type I, minimum, asbestos free.
2. VOC Content: Not more than permitted by local, State, and federal regulations.
3. Applied Thickness: 1/16 inch, minimum, wet film.

B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

A. Cavity Wall: Apply two coats of asphalt dampproofing.

B. Apply bitumen by spray application.

C. Seal items watertight with mastic, that project through dampproofing surface.

END OF SECTION

SECTION 07 19 00

WATER REPELLENTS

PART I GENERAL

1.01 SUMMARY

A. Section Includes:

1. Volatile Organic Compound (VOC) compliant water-based penetrating sealer field applied to completed exterior DRY-BLOCK CMU wall construction to:

a. Further prevent intrusion of water into completed wall.

b. Reduce attack from water-borne contaminants.

c. Minimize the occurrence of efflorescence, mold, mildew, and algae.

B. Related Sections:

1. Section 04 20 00 – Unit Masonry

1.02 PERFORMANCE REQUIREMENTS

A. ASTM E 514, “Standard Test Method for Water Penetration and Leakage through Masonry.”

B. VOC Content: EPA Method 24.

C. ASTM E 96, “Test Methods for Water Vapor Transmission of Materials.”

D. Water Repellency Test – Capillary Test: “Grace Construction Products, Method 698.”

E. Water Repellency Test – 63.5 mm (2½ in.) Hydrostatic Head: “Grace Construction Products, Method HU 698.”

F. Accelerated Weathering: QUV (2,000 hours).

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Reduce absorption of water and waterborne contaminants into substrate.

2. Permit water vapor transmittance.

3. No change to slight darkening of substrate after application.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00

1. Spec-Data® Sheet on Grace Construction Products INFINISEAL DB Water-Repellent Sealer for DRY-BLOCK Admixture Wall Systems.

2. Technical Brochure on Grace Construction Products INFINISEAL DB Water-Repellent Sealer.

3.. Test Report prepared by a qualified independent laboratory indicating compliance with the performance requirements for water-repellent sealer compatible with the integral water-repellent admixture wall system as tested using ASTM E 514, extended to 72 hours.

4. Technical data sheet indicating compliance with the performance requirements for water-repellent sealer compatible with the integral water-repellent admixture wall system as tested using:

a. EPA Method 24.

b. ASTM E 96.

c. “Grace Construction Products Method 698.”

d. “Grace Construction Products Method HU 698.”

e. QUV for 2,000 hours.

5. Material Safety Data Sheets (MSDS) for water-repellent sealer maintained on project site during application period.

1.05 QUALITY ASSURANCE

A. Mockups:

1. Perform application test to 1.5 m x 1.5 m (5 ft x 5 ft) section of CMU wall surface to determine:

    a. Proper sealer coverage rate for type of CMU being sealed. Typical sealer coverage rate ranges from 1.2 to 3.7 m2/L (50 to 150 ft2/gal). Where overall coverage rates are less than 1.9 m2/L (80 ft2/gal), use 2-coat application method.

    b. Desired water-repellency properties.

    c. Desired surface appearance after sealer is fully dry.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store materials in a dry area at a temperature between 40º and 100º F (0 to 38 degrees C). Provide adequate ventilation and keep away from ignition sources.

B. Do not allow water-repellent sealer to freeze; discard any frozen sealer.

1.07 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply water-repellent sealer when wall surface, air, and sealer temperatures are less than 4°C (40°F) or greater than 38°C (100°F).

2. Do not apply if rain or temperatures below 40 degrees F (4 degrees C) are expected within 6 hours after application.

3. Do not apply during winds that could carry water repellent to adjacent surfaces, properties, or vegetation.

4. Do not apply sooner than 24 hours after surface has been exposed to rain or other water source.

B. Substrate:

1. Cured minimum 30 days.

2. Not frozen or frost covered.

3. Clean, sound, and dry.

C. Ensure adequate ventilation in application areas.

D. Joint sealers, paints, and glazing compounds and sealants fully cured.

1.08 SEQUENCING

A. Apply water repellents after installation of joint sealers.

1.09 WARRANTIES

A. Provide manufacturer's 5 year material replacement warranty.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Grace Construction Products

62 Whittemore Avenue

Cambridge, MA 02140

www.graceconstruction.com

B. Professional Products of Kansas, Nc.: www.watersealant.com

2.02 MATERIALS

A. Water Repellent Product: INFINISEAL DB Water-Repellent Sealer manufactured by Grace Construction Products.

1. Description: Specially-formulated, VOC-compliant, clear, penetrating sealer consisting of water-based blend of silanes and siloxanes to provide maximum water-repellency when post-applied to integrally water-repellent-treated CMU wall construction.

2. Water Permeance: Capable of achieving a Class E Rating when evaluated using ASTM E 514 with the test extended to 72 hours, using the rating criteria specified in ASTM E 514-74.

3. Volatile Organic Compound Content: Maximum 320 g/L.

4. Moisture Vapor Transmission Rate: Minimum 95% compared to unsealed normal weight integral water-repellent sample using ASTM E 96.

5. Depth of Penetration: 15 mm (9⁄16 in.) to 35 mm (13⁄8 in.) depending on density of CMU, as observed visually.

6. Water Repellency – Capillary Test: Minimum 82% reduction in water uptake versus unsealed normal weight integral water-repellent CMU using Method 698.

7. Water Repellency – 63.5 mm (2½ in.) Hydrostatic Head Pressure: Minimum 86% reduction in water uptake versus unsealed normal weight integral water-repellent CMU using Method HU 698.

8. Accelerated Weathering: Minimal color change using QUV for 2,000 hours.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface Preparation:

1. Ensure surface area of CMU to be treated is clean and dry, free of chemical cleaners, efflorescence, dirt, oils, mortar smears, and other surface contaminants.

2. Repoint any loose, cracked, or disintegrated mortar a minimum of 7 days before applying water-repellent sealer.

3. Ensure all joint sealants and caulking is fully cured.

B. Surrounding Area Protection:

1. Take necessary precautions to protect all areas surrounding surfaces to be treated with water-repellent sealer, including masking windows and metals, and covering plants, grass, and any other non-CMU surfaces with either polyethylene sheeting or drop cloth materials before and during sealer application.

2. Take necessary safety precautions to keep all personnel not involved in application of water-repellent sealer and pedestrians away from application area.

3. Avoid overspray by wind drift and/or improper application procedures.

3.02 APPLICATION

A. Spray Application:

1. Use low-pressure airless spray equipment fitted with fan tip between 0.6 mm (0.025 in.) and 0.8 mm (0.035 in.).

2. Apply at lowest pressure setting that ensures continuous spray without surge.

3. Using 0.9 m to 1.2 m (3 ft to 4 ft) wide swathes, start spraying from bottom of CMU wall and work to top of wall, avoiding spray atomization and applying sufficient material to saturate CMU wall with maximum 150 mm (6 in.) sealer rundown.

4. When necessary, apply second coat, wet-on-wet, at twice the coverage rate as first coat within one hour of first spray application, per pre-application testing to ensure proper surface saturation, coverage, and product performance.

B. Brush or Roller Application:

1. Use either nylon or other synthetic brushes or rollers resistant to alkalinity.

2. Apply water-repellent sealer to area to be treated, thoroughly saturating CMU and avoiding excessive overlapping.

3. Cleaning:

a. Clean all equipment with hot, soapy water.

b. Clean all windows or surrounding areas accidentally oversprayed on same day of application using warm, soapy water.

c. If feasible, to make cleaning easier, pretreat windows with soapy water just prior to sealer application and clean windows immediately after sealer application, while the sealer is still wet.

d. If overspray is allowed to dry, clean surface with solvents such as mineral spirits or typical scraping methods.

3.03 FIELD QUALITY CONTROL

A. At least two weeks before starting above-grade masonry work, schedule a pre-installation conference at the jobsite in accordance with Section 01200 to discuss compliance with the requirements of the contract documents. Give two weeks advance notice to the participants, including the contractor, mason contractor, flashing installer, CMU producer, and/or the manufacturer of the integral water-repellent CMU admixture and sealer. Advise the architect of the scheduled meeting date.

B. Inspection: Inspect the water repellent work with the Contractor, Architect, and applicator and compare with test panel results approved by the Architect. Determine if the substrates are suitably protected by the water repellents. After coating has dried, test surfaces with water spray and Material Absorption Tube test; reapply to any areas showing water absorption.

3.04 FINAL CLEANING

A. Clean site of all unused water repellents, residues, rinse water, wastes, and effluents in accordance with environmental regulations.

B. Remove and dispose of all materials used to protect surrounding areas and non-masonry surfaces, following completion of the work of this section.

C. Repair, restore, or replace to the satisfaction of the Architect, all materials, landscaping, and non-masonry surfaces damaged by exposure to water repellents.

END OF SECTION

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SECTION 07 51 00

BUILT-UP BITUMINOUS ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Built-up roofing membrane, conventional application.

B. Base flashings.

C. Roofing cant strips, accessories, and roofing vents.

1.02 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012.

B. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2016).

C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017.

D. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2016a.

E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007, with Editorial Revision (2012).

F. NRCA (RM) - The NRCA Roofing Manual; 2018.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

1.04 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above _____ degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when

precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

PART 2 PRODUCTS

2.01 MANUFACTURERS

1. Johns Manville: www.jm.com
2. Siplast: www.siplast.com
3. Soprema: www.soprema.us

2.02 ROOFING - CONVENTIONAL APPLICATION

A. Built-up Bituminous Roofing: Asphalt felt membrane, three ply plus base sheet, with vapor retarder and insulation. Patch roof as needed to match existing standards.

2.03 SHEET MATERIALS

B. Vapor Retarder Felt: Asphalt-saturated organic, ASTM D226/D226M, Type I ("No.15") felt, unperforated.

2.04 BITUMINOUS MATERIALS

C. Bitumen: ASTM D312/D312M Type I, asphalt.

D. Primer: ASTM D41/D41M, asphalt type.

E. Roof Cement: ASTM D4586/D4586M, Type I, asbestos free.

2.05 INSULATION

F. Cellulose Fiber Board Insulation: ASTM C208, Type II, both faces finished with mineral fiber, asphalt and kraft paper.

1. Board Size: 48 by 96 inch.

2. Board Thickness: 1/2 inch per board to full thickness needed to patch to match to existing standards.

3. Board Edges: Square.

4. Thermal Conductivity (k-value): 0.38 Btu in/hr sq ft degrees F at 75 degrees F.

5. Manufacturers:

    a. Blue Ridge Fiberboard; STRUCTODEK: www.blueridgefiberboard.com/#sle.

2.06 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 MEMBRANE APPLICATION

A. Install built-up bituminous roofing system in accordance with manufacturers recommendations and NRCA (RM) applicable requirements. Patch to match existing standards.

B. Apply membrane plies, weather lap edges and ends, and mop with 20 lbs/square (100 sq ft) of bitumen per ply. Apply plies 2 on 2 in same direction.

C. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears.

D. At end of day's operation, install two plies membrane and bitumen glaze coat for cut-off. Glaze exposed felts. Remove cut-off before resuming roofing.

E. At intersections with vertical surfaces:

1. Extend membrane and base sheet over cant strips and up a minimum of 4 inches onto vertical surfaces.
2. Mop on base flashing of two additional plies of felt and one ply of base flashing material.

F. Around roof penetrations, mop in and seal flanges and flashings with two additional plies of felt.

G. Coordinate installation of roof drains and related flashings.

3.03 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.04 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

1.02 REFERENCES

A. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2008.

B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2010.

C. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2009.

1.03 SUBMITTALS

A. See Section 013300 - Product Requirements, for submittal procedures.

B. Product Data: Provide data indicating sealant chemical characteristics.

C. Manufacturer's Installation Instructions: Indicate special procedures.

1.04 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.06 COORDINATION

A. Coordinate the work with all sections referencing this section.

1.07 WARRANTY

A. Correct defective work within a five year period after Date of Substantial

Completion.

B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Polyurethane Sealants:

1. Bostik, Inc: www.bostik-us.com.
2. Pecora Corporation: www.pecora.com.
3. BASF Construction Chemicals, Inc: www.chemrex.com.

B. Polysulfide Sealants:

1. Pecora Corporation: www.pecora.com.
2. BASF Construction Chemicals, Inc: www.chemrex.com.

C. Acrylic Sealants:

1. Tremco, Inc: www.tremcosealants.com.

2.02 SEALANTS

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

B. Type 2 - General Purpose Exterior Sealant for joints in vertical and sloping surfaces; Polyurethane and Polysulfide; single component.

1. Color: Standard colors matching finishing surfaces.

C. Type 1; self-leveling - General Purpose Exterior Sealant for joints on horizontal surfaces; Polyurethane and Polysulfide; single component.

1. Color: Standard colors matching finished surfaces.

2.03 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit

application.

B. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 25 to 50 percent larger than joint width.

C. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter which might impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C 1193.

C. Perform acoustical sealant application work in accordance with ASTM C 919.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

END OF SECTION

SECTION 08 16 13

FIBERGLASS DOORS & ALUMINUM FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic (FRP) doors w/ aluminum frames.

B. Hinges and other door hardware.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Other door hardware.

1.03 REFERENCE STANDARDS

A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

D. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007 (Reapproved 2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Obtain hardware templates from hardware manufacturer prior to starting fabrication.

1.05 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard details, installation instructions, and hardware and anchor recommendations.

C. Test Reports: Show compliance with specified criteria.

D. Shop Drawings: Show layout and profiles; include assembly methods.

1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.

2. Indicate wall conditions, door and frame elevations, sections, materials, gages, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on Drawings to identify details and openings.

E. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer's available finishes, colors, and textures.

F. Verification Samples: Submit door surface samples for each finish specified, 10 inch (254 mm) by 10 inch (254 mm) in size, illustrating finishes, colors, and textures.

G. Door Corner Sample: Submit corner cross sections, 10 inch (254 mm) by 10 inch (254 mm) in size, illustrating construction, finish, color, and texture.

H. Maintenance Data: Include instructions for repair of minor scratches and damage.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in installing products of the type specified in this section with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Mark doors with location of installation, door type, color, and weight.

B. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.

1. Store at temperature and humidity conditions recommended by manufacturer.
2. Do not use non-vented plastic or canvas shelters.
3. Immediately remove wet wrappers.

D. Store in position recommended by manufacturer, elevated minimum 4 inch (102 mm) above grade, with minimum 1/4 inch (6.4 mm) space between doors.

1.08 FIELD CONDITIONS

A. Do not install doors until structure is enclosed.

B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of doors.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five (5) year manufacturer warranty covering materials and workmanship including degradation or failure due to chemical contact.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Laminated Fiberglass Doors:

1. Ceco Door Products : www.cecodoor.com.
2. Corrim Company : www.corrim.com.
3. Fib-R-Dor : www.fibrdor.com.
4. Oregon Door : www.oregondoor.com.
5. Curries / Assa Abloy: www.curries.com
6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOOR AND FRAME ASSEMBLIES

A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.

1. Door and frame pre-assembled , complete with hinges; shipped with braces,

spreaders, and packaging as required to prevent damage.

2. Mechanical Durability: Tested to ANSI/SDI A250.4 Level A (1,000,000 cycles), minimum; tested with hardware and fasteners intended for use on project.
3. Screw-Holding Capacity: Tested to 900 psi (6200 kPa), minimum.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A; when tested in accordance with ASTM E84.
5. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
6. Chemical Resistance: Resist degradation due to exposure to tap water and distilled water.
    a. Sewage and moisture-laden air in sewage treatment areas.
    b. Chlorine-treated moisture in air.
    c. Ocean salt spray.
7. Clearance between Door and Frame: 1/8 inch (3 mm), maximum.
8. Clearance Between Bottom of Door and Finished Floor: 3/4 inch (19 mm), maximum; not less than 1/4 inch (6 mm) clearance to threshold.

2.03 COMPONENTS

A. Doors: Through-color gel coating on fiberglass reinforced polyester resin construction with reinforced core.
    1. Thickness: 1-3/4 inches (44 mm), overall.
    2. Door Construction: Fiberglass faces laminated to core with subsequently applied gel coating, or molded in one piece including gel coating on all sides.
    3. Subframe and Reinforcements: Fiberglass pultrusions or polymer foam; no metal or wood.
    4. Waterproof Integrity: All edges, cut-outs, and hardware preparations factory fabricated of fiberglass reinforced plastic; provide cut-outs with joints sealed independently of glazing or louver inserts or trim.
    5. Hardware Preparations: Factory reinforce, machine, and prepare for all

hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary; obtain manufacturer's templates for hardware preparations.

6. Gel Coating: Ultraviolet stabilized polyester, marine grade NPG-isophthalic, with slightly textured semi-gloss final finish.

7. Gel Coating Thickness: Minimum 15 mils (0.38 mm) wet, plus/minus 3 mils (0.07 mm).

8. Gel Coating Color: As selected by Architect.

B. Frames: Profiles and dimensions as indicated on drawings; same type and construction used in mechanical durability test for doors.

1. Extruded Aluminum: ASTM B 221 alloy 6063-T5 or allow and temper required to suit structural and finish requirements.

a. Provide aluminum frame components that comply with dimensions, profiles and relationships to adjoining work of components indicated on the drawings.

b. Extruded aluminum, rabbet wall thickness is nominal 0.062 inch thick, reinforced for hinges and strikes.

2. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless steel spot welded; sealed watertight with silicone sealant.

3. At hardware cut-outs provide continuous backing or mortar guards of same material as frame, sealed watertight.

4. Frame Anchors: Stainless steel, Type 304; provide 3 anchors in each jamb for heights up to 84 inches (2130 mm) with one additional anchor for each additional 24 inches (610 mm) in height.

C. Hinge and Hardware Fasteners: Stainless steel, Type 304; wood screws.

2.04 ACCESSORIES

A. Louver Stops: Pultruded fiberglass unless otherwise indicated or required by fire rating; provided by door manufacturer to fit factory made openings, color and texture to match door; fasteners not penetrating waterproof integrity.

1. Exterior Doors: Provide non-removable stops on outside and continuous

compression gasket weatherseal.

2. Opening Sizes: As indicated on drawings.

B. Louvers for Non-Fire-Rated Doors: Same materials, construction, finish, and color as door; fixed vanes, 45 degree sloped vanes.

1. Insect Screens: Fiberglass mesh.

C. Hardware: As specified in Section 08 71 00.

D. Thresholds: Pultruded fiberglass, with skid resistant surface, full width of door opening, 1/2 inch (13 mm) high by 6 inches (150 mm) wide; same color as frame.

E. For Aluminum frames: Use nonmagnetic stainless steel or other non-corrsive metla fasteners compatible with frames, stops, panels, reinforced plates, hardware, anchors and other items being fastened.

F. Door silencers (Mutes): manufacturer’s standard mohair or vinyl.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Clean and prepare substrate in accordance with manufacturer's directions.

C. Protect adjacent work and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions; do not penetrate frames with

anchors.

B. Install exterior doors in accordance with ASTM E2112.

C. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.

D. In masonry walls, install frames prior to laying masonry; anchor frames into masonry mortar joints; fill jambs with grout as walls are laid up.

E. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

F. Repair or replace damaged installed products.

3.04 ADJUSTING

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.

B. Adjust hardware for smooth and quiet operation.

C. Adjust doors to fit snugly and close without sticking or binding.

3.05 CLEANING

A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

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SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for hollow metal doors.

B. Hardware for fire-rated doors.

C. Thresholds.

D. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 08 16 13 – Fiberglass Doors and Aluminum Frames.

1.03 REFERENCE STANDARDS

A. BHMA A156.1 - American National Standard for Butts and Hinges; 2016.

B. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2017.

C. BHMA A156.3 - American National Standard for Exit Devices; 2014.

D. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.

E. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.

F. BHMA A156.6 - American National Standard for Architectural Door Trim; 2015.

G. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2016.

H. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2015.

I. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2015.

J. BHMA A156.21 - American National Standard for Thresholds; 2014.

K. BHMA A156.22 - American National Standard for Door Gasketing and Edge

Seal Systems, Builders Hardware Manufacturers Association; 2017.

L. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

M. ITS (DIR) - Directory of Listed Products; current edition.

N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2018.

P. UL (DIR) - Online Certifications Directory; Current Edition.

Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

1.05 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Closers: Five years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.

2. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

3. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), testing firm acceptable to authorities having jurisdiction, or as suitable for application indicated.

2.02 HINGES

A. Manufacturers:

1. Basis of Design:_____.

2. Corbin Russwin; an Assa Abloy Group company; www.assaabloydss.com

B. Hinges: Complying with BHMA A156.1, Grade 1.

1. Provide hinges on every swinging door.

2. Provide five-knuckle full mortise butt hinges unless otherwise indicated.

3. Provide ball-bearing hinges at each door with closer.

4. Provide non-removable pins on exterior outswinging doors.

5. Provide following quantity of butt hinges for each door:

a. Doors From 60 inches High up to 90 inches High: Three hinges.

ANSI A 156.1 Compliant full mortise type hinges
ANSI A5111 (Stainless steel) For use on heavy weight doors and doors requiring high frequency service.

2.03 EXIT DEVICES

A. Manufacturers:

1. Basis of Design:

2. Corbin Russwin; an Assa Abloy Group company; www.assaabloydss.com

B. Exit Devices: Complying with BHMA A156.3, Grade 1.

1. Lever design to match lockset trim.
2. Provide cylinder with cylinder dogging or locking trim.
3. Provide exit devices properly sized for door width and height.
4. Provide strike as recommended by manufacturer for application indicated.
5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.04 LOCK CYLINDERS

A. Manufacturers:

1. Basis of Design:
2. Corbin Russwin; an Assa Abloy Group company; www.assaabloydss.com

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

1. Provide cylinders from same manufacturer as locking device.
2. Provide cams and/or tailpieces as required for locking devices.

2.05 COORDINATORS

A. Manufacturers:

1. Basis of Design:
2. Corbin Russwin; an Assa Abloy Group company; www.assaabloydss.com
3. DORMA USA, Inc; TS93 GSR: www.dorma.com/#sle.

4. Hiawatha, Inc, division of Activar Construction Products Group, Inc: www.activarcpg.com/hiawatha.
5. Ives, an Allegion brand: www.allegion.com/us.
6. Pamex, Inc: www.pamexinc.com/#sle.
7. Trimco: www.trimcohardware.com.

B. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
1. Type: Bar, unless otherwise indicated.
2. Material: Aluminum, unless otherwise indicated.
3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.06 CLOSERS

A. Manufacturers; Surface Mounted:
1. Basis of Design.
2. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.

B. Closers: Complying with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.

2.07 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
1. Basis of Design.
2. Rixson or Sargent; an Assa Abloy Group company;__: www.assaabloydss.com.
3. C. R. Laurence Company, Inc;___: www.crl-arch.com.
4. DORMA USA, Inc; 900 Series: www.dorma.com/#sle.
5. Glynn-Johnson, an Allegion brand;___: www.allegion.com/us.
6. Pamex, Inc;____: www.pamexinc.com/#sle.

B. Overhead Stops and Holders (Door Checks): Complying with BHMA A156.8, Grade 1.

1. Provide stop for every swinging door, unless otherwise indicated.

2.08 PROTECTION PLATES

A. Manufacturers:

1. Basis of Design:
2. Rockwood; an Assa Abloy Group company;__: www.assaabloydss.com.
3. C. R. Laurence Company, Inc;___: www.crl-arch.com.
4. Hager Companies;____: www.hagerco.com/#sle.
5. Hiawatha, Inc, an Activar Construction Products Group company;_____: www.activarcpg.com/hiawatha.
6. Ives, an Allegion brand;____: www.allegion.com/us.
7. Pamex, Inc;_____: www.pamexinc.com/#sle.
8. Trimco;_____: www.trimcohardware.com.

B. Protection Plates: Complying with BHMA A156.6.

C. Metal Properties: Aluminum.

1. Metal, Heavy Duty: Thickness 0.062 inch, minimum.

D. Edges: Beveled, on four sides unless otherwise indicated.

E. Fasteners: Countersunk screw fasteners.

2.09 THRESHOLDS

A. Manufacturers:

1. Basis of Design:
2. Pemko; an Assa Abloy Group company;__: www.assaabloydss.com.
3. Hager Companies;____: www.hagerco.com/#sle.
4. National Guard Products, Inc;___: www.ngpinc.com.
5. Reese Enterprises, Inc;____: www.reeseusa.com/#sle.

6. Zero International, Inc;___: www.zerointernational.com.

B. Thresholds: Complying with BHMA A156.21.

1. Provide threshold at each exterior door, unless otherwise indicated.

2. Type: Flat surface.

3. Material: Aluminum.

4. Threshold Surface: Fluted horizontal grooves across full width.

5. Field cut threshold to profile of frame and width of door sill for tight fit.

6. Provide non-corroding fasteners at exterior locations.

2.10 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:

1. Basis of Design:

2. Pemko; an Assa Abloy Group company;__: www.assaabloydss.com.

3. Hager Companies;____: www.hagerco.com/#sle.

4. National Guard Products, Inc;___: www.ngpinc.com.

5. Reese Enterprises, Inc;____: www.reeseusa.com/#sle.

6. Zero International, Inc;____: www.zerointernational.com. 7. _____.

B. Weatherstripping and Gasketing: Complying with BHMA A156.22.

1. Head and Jamb Type: Adjustable.

2. Door Sweep Type: Encased in retainer.

3. Material: Aluminum, with brush weatherstripping.

4. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .

5. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.11 WEATHER PROOFING

A. Manufacturers:

1. Basis of Design: Floor Barrier Shield by Zero International: http://www.zerointernational.com/images/news/publications/FBS_booklet.pdf

B. FIRE DEPARTMENT LOCK BOX

1. Manufacturers:

a. Knox Company; Knox-Box Rapid Entry System,__: www.knoxbox.com.

2. Fire Department Lock Box:

a. Capacity: Holds 10 keys.

b. Finish: Manufacturer's standard dark bronze.

C. FINISHES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Use templates provided by hardware item manufacturer.

D. Do not install surface mounted items until application of finishes to substrate are fully completed.

E. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.

F. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01 45 10 - Quality Control.

3.04 ADJUSTING

A. Adjust work under provisions of Section 01 7000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean adjacent surfaces soiled by hardware installation.

B. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 01 78 00 – Contract Closeout.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

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SECTION 09 90 00

PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

Painting of plaster, wood, metal, masonry, and other surfaces designated to be painted except factory-applied finishes.

1.02 RELATED SECTIONS

A. Section 07 92 00 - Joint Sealants

B. Section 09 91 13 - Exterior Painting

C. Section 09 91 23 – Interior Painting

1.03 REFERENCES

A. American Water Works Association, Inc. (AWWA) latest edition:

1. AWWA D100 - Welded Steel Tanks For Water Storage
2. AWWA D102 - Coating Steel Water Storage Tanks

B. Steel Structures Painting Council (SSPC) latest edition Specifications:

1. SSPC-SP 1 - Solvent Cleaning
2. SSPC-SP 2 - Hand Tool Cleaning
3. SSPC-SP 3 - Power Tool Cleaning
4. SSPC-SP 5 - White Metal Blast Cleaning
5. SSPC-SP 6 - Commercial Blast Cleaning
6. SSPC-SP 7 - Brush Off Blast Cleaning
7. SSPC-SP10 - Near White Blast Cleaning
8. Steel Structures Painting Manual - Volume 2
9. ICRI – International Concrete Repair Institute

C. OSHA

1. 1926 Subpart C – General Safety and Health Provisions
2. 1926 Subpart D – Occupational Health and Environmental Controls
3. 1926 Subpart E – Personal Protective and Life Saving Equipment
4. 1926 Subpart F – Fire Protection and Prevention
5. 1926 Subpart H – Material Handling, Storage, Use, and Disposal
6. 1926 Subpart Z – Toxic and Hazardous Substances

1.04 DEFINITIONS

A. Coating = emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, whether used as prime, intermediate, or finish coats.

B. DFT = abbreviation for Dry Film Thickness.

1.05 SYSTEM DESCRIPTION

A schedule of coating colors will be provided by the E/A after award. The Contractor shall base his bid on ceilings of a color different than walls and an average of two wall colors per room or area. Colors other than those shown in the manufacturer's standard color charts may be required for building finishes. Strong colors may be selected for doors, piping, equipment, and miscellaneous features. Exterior building or structure colors will be limited to two plus trim.

1.06 SUBMITTALS

A. Within 30 days after award of the Contract, the Contractor shall notify the E/A, in writing, the name of the paint manufacturer for the Project.

B. Prior to submitting shop drawings for any item requiring shop or field applied primer or finish coatings, submit to the E/A a Painting Schedule, indicating major items to be painted, preparation, paint manufacturer, product designation, and dry mill thickness. This submittal shall include the manufacturer's written recommendation of the type paint for each item to be painted.

C. Upon request submit three 8-1/2 inch x 11-inch samples of requested colors for approval by the E/A.

1.07 QUALITY ASSURANCE

A. Unless otherwise specified, all work and materials for the preparation and coating of all metal surfaces shall conform to the applicable requirements specified in the Steel Structures Painting Manual, Volume 2, Systems and Specifications Revised, latest edition, published by the Steel Structures Painting Council.

B. It is the intent of this Specification that the Contractor use one paint manufacturer throughout, unless otherwise approved by the E/A. Products shall be manufactured by one of the following, or equal:

1. Tnemec - Tnemec Co., Inc., North Kansas City, Missouri.
2. Porter - Porter Paint Company, Louisville, Kentucky.
3. Glidden-Glidden Coatings and Resins, Cleveland, Ohio.
4. Induron-Induron Coatings Inc., Birmingham, Alabama

C. Manufacturers other than the above shall submit product data for all products specified in this Section to the E/A for approval. No request for substitution will be considered which decreases the dry film thickness and/or the number of coats to be applied, or which offers a change from the generic type of coating specified. Bidders desiring to use paints other than those specified shall submit their proposal based on the specified materials, together with the information noted above, and indicate the sum which will be added to or deducted from the base bid, should the alternate materials be acceptable.

1.08 PAINTING CONFERENCE

A. At the request of the Owner/Engineer the Contractor shall schedule a conference of the painter, Owner, a technical representative of the paint supplier, and the E/A to discuss painting requirements and finalize color selections before painting is started.

B. Prior to painting any surface the Contractor shall schedule a meeting with the painter and an Owners/Engineers representative to inspect the surface preparation and verify that the surface is ready for painting. Failure to inspect a surface prior to coating could result in the rejection of the coating. Alternate products must be submitted at least 10 days before the bid opening.

1.09 SAMPLES

A. Paint colors will be selected by the Engineer with final approval by the Owner. Compliance with all other requirements is the exclusive responsibility of the Contractor.

B. Samples of each finish and color shall be submitted to the Engineer for approval before any work is started.

C. Samples shall be prepared so that an area of each sample indicates the appearance of the various coats, For example, where three coat work is special, the sample shall be divided into three areas: one showing application of one coat only, one showing the application of two coats, and the third showing the application of three coats.

D. Such samples when approved in writing shall constitute a standard, as to color and finish only, of acceptance or rejection of the finish work.

E. For piping, valves, equipment, and miscellaneous metal work, provide sample chips or color charts of all paint selected showing color, finish and the general characteristics.

F. Rejected samples shall be resubmitted until approved.

G. Before proceeding with room painting, the Contractor shall finish paint one complete room. After approval, this sample room shall serve as a standard for texture and workmanship throughout the project.

1.10 DELIVERY AND STORAGE

A. All materials shall be delivered to the job in original sealed and labeled containers of the paint manufacturer, and shall be subject to inspection by the E/A. Labels shall show name of manufacturer, batch numbers, type of coating, formulation, color and instructions for reducing.

B. Storage areas out side of the structures being constructed will be submitted by the Contractor for the E/A to review for the storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. The Contractor shall take all safety precautions in accordance with Section 7 of AWWA D102, NFPA Bulletin No. 101 and all federal, state and local

regulations. Proper containers outside of the buildings/structures shall be provided and used by the Contractor for painting wastes.

C. Exercise every precaution in the storing of paints, solvents, cleaning fluids, rags, and similar materials as to eliminate the risk of spontaneous combustion or other hazardous conditions.

PART 2 PRODUCTS

2.01 MISCELLANEOUS MATERIALS

A. All materials used in the work except oils and thinners, shall be of the brands and qualities specified.

B. All cleaners, thinners, and other additives and surface pretreatment materials shall only be those approved for use by the manufacturer of the coatings.

C. Do not dilute paints except as recommended by the paint manufacturer.

D. Paint containing lead or chromate is not allowed.

D. Protective coatings for surfaces which will be in contact with potable water shall be listed by NSF International as approved for potable water contact in accordance with ANSI/NSF Std. 61, Section 5 Protective (Barrier) Materials.

E. Emulsion and alkyd paint shall contain a mildewcide and both the paint and mildewcide shall conform to OSHA and Federal requirements, including Federal Specification TT-P-19.

2.02 PAINT SYSTEMS GUIDE

A. The following table illustrates the general features of the standard coating systems and is provided as a general guideline, and may be superseded by specific coating requirements outlined within this specification or on the Drawings:

System No.	Generic Type	Surface Material	Finish	Typical Function
1	Epoxy / Polyurethane	Ferrous Metal, Non-galvanized	Gloss	Exterior metals not subject to immersion or frequent splashing
2	Polyurethane	Ferrous Metal, galvanized	Gloss	Exterior metals not subject to immersion or frequent splashing
3	Epoxy	Ferrous Metal, Non-galvanized	Semi-gloss	Interior metals not subject to immersion or frequent splashing or condensation
4	Alkyd	Ferrous Metal, galvanized	Semi-gloss	Interior metals not subject to immersion or frequent splashing or condensation
5	Epoxy	Ferrous Metal, Non-galvanized	Semi-gloss	Interior metals subject to condensation
6	Epoxy	Ferrous Metal, galvanized	Semi-gloss	Interior metals subject to condensation
7	Epoxy	Ferrous Metal, Non-galvanized	Semi-gloss	Metals subject to immersion or frequent splashing
8	Epoxy	Ferrous Metal, galvanized	Semi-gloss	Metals subject to immersion or frequent splashing
9	Epoxy	Concrete	Semi-gloss	Interior

System No.	Generic Type	Surface Material	Finish	Typical Function
10	Epoxy	Concrete	Tile-like gloss	Interior walls of washrooms
11	Acrylic	Concrete	Low sheen	Precast concrete ceilings, beams, columns
12	Elastomeric	Concrete	Low sheen	Exterior concrete
13	Epoxy	Masonry	Semi-gloss	Interior masonry
14	Epoxy	Masonry	Tile-like gloss	Interior walls of washrooms
15	Elastomeric	Masonry	Low sheen	Exterior masonry
16	Acrylic	Masonry	Low sheen	Interior masonry
17	Acrylic	Drywall, plaster	Low sheen	Interior drywall, plaster
18	Acrylic	Plaster, stucco	Low sheen	Exterior plaster, stucco
19	Alkyd	Wood	Gloss	Exterior wood
20	Alkyd	Wood	Semi-gloss	Exterior wood
21	Alkyd	Wood	Gloss	Interior wood
22	Alkyd	Wood	Semi-gloss	Interior wood

System No.	Generic Type	Surface Material	Finish	Typical Function
23	Acrylic	Wood	Low sheen	Interior wood
24	Acrylic	Canvas wrapped insulation	Semi-gloss	Canvas wrapped insulated piping
25	Coal Tar Epoxy	Ferrous Metal	Semi-gloss	Metals submerged in non-potable water
26	Coal Tar Epoxy	Concrete	Semi-gloss	Submerged concrete in non-potable water or below grade
27	Epoxy	Ferrous Metal	Semi-gloss	Metals submerged in potable water
28	Epoxy	Concrete	Semi-gloss	Concrete submerged in potable water
29	Sealer, Hardener	Concrete	Semi-gloss	Concrete Floors

2.03 COATING SYSTEMS

A. System No. 1

1. System No. 1 shall be used for exterior non-galvanized ferrous metals that are not subject to immersion or frequent splashing of water or wastewater, including but not limited to the following:

   a. Exposed exterior piping, valves and fittings.

   b. Exterior mechanical equipment, control panels, miscellaneous metal, etc. without a factory-applied final finish.

2. System No. 1 surface preparation shall be SP 6.

3. System No. 1 shop primer shall be one coat of one of the following, or

equal:

a. Induron P-14 Armorguard Primer at 3.0 - 5.0 mils DFT

b. Tnemec 37H-77 Chem-Prime Universal Primer at 2.0 mils DFT.

c. Glidden 5205 Glid-Guard Tank and Structural Primer at 2.0 mils DFT

4. System No. 1 field touch-up shall be the same material as Shop Primer. Clean damaged or bare areas by Power Tool Cleaning per SSPC SP3.

5. System No. 1 intermediate coats shall be two (2) coats of one of the following, or equal:

a. Induron Armorguard Epoxy at 3.0 to 5.0 mils DFT

b. Tnemec Series 2 Tneme-Gloss at 1.5 mils DFT per coat.

c. Glidden Life Master Pro High Performance Acrylic No.6900 at 1.5 mils DFT

6. System No. 1 finish shall be one full coat of High Gloss aliphatic polyurethane, of one of the following, or equal:

a. Induron Indurethane 5500 Gloss Enamel at 1.5 to 2.5 mils DFT

b. Tnemec Series 2H Tneme-Gloss at 1.5 mils DFT per coat.

c. Glidden Life Master Pro High Performance Acrylic No. 6900 Series at 1.5 mils dry coat.

B. System No. 2

1. System No. 2 shall be used for exterior galvanized ferrous metals which are not subject to immersion or frequent splashing of water or wastewater, including but not limited to the following:

a. Exposed galvanized piping and fittings.

b. Exposed galvanized conduit, equipment, miscellaneous metal, etc. without a factory-applied final finish.

2. System No. 2 surface preparation shall be SP M1.

3. System No. 2 field clean-up includes removing all grease, oil and

contaminants with rags soaked in Toluol or Xylol in accordance with SSPC-SP 1 Solvent Cleaning.

4. System No. 2 primer shall be one coat of one of the following, or equal:

   a. Induron Vinyl Wash Primer at 0.5 to 1.0 mils DFT

   b. Tnemec Series 66 Hi-Build Epoxoline at 20.-4.0 mils DFT.

   c. Porter 1799 V.C.-17 Wash Prime at 0.5 mil DFT.

   d. Glidden Glid-Guard Tank & Structural Primer No. 5205/5206/5207 at 2.0 mils DFT.

5. System No. 2 finish shall be two (2) coats of one of the following or equal:

   a. Induron Indurethane 5500 Gloss Enamel at 1.5 to 2.5 mils DFT per coat

   b. Tnemec Series 2H Tneme-Gloss at 1.5 mils DFT per coat.

   c. Porter I.A.-24 Gloss Finish at 1.5 mils DFT per coat.

   d. Glidden 4550 Series Glid-Guard Alkyd Industrial Enamel at 2.0 mils DFT per coat.

C. System No. 3

1. System No. 3 shall be used for interior, non-galvanized, ferrous metals not subject to immersion, frequent splashing or condensation, including but not limited to the following:

   a. Interior piping, valves and fittings, except piping subject to condensation.

   b. Exposed structural steel.

   c. Steel stairs and railings.

   d. Interior cranes and hoists.

   e. Steel doors and frames.

   f. Interior equipment, control panels, miscellaneous metal, etc. without a factory-applied final finish.

2. System No. 3 surface preparation shall be SP 6.

3. System No. 3 shop primer shall be one coat of one of the following, or equal:

   a. Induron P-14 Armorguard Primer at 3.0 to 5.0 mils DFT

   b. Tnemec 37-77 Chem-Prime Universal Primer at 2.0 mils DFT or N69 Hi-Build Epoxoline II at 3.0-5.0 mils DFT.

   c. Porter U-Prime Universal Primer at 2.0 mils DFT.

   d. Glidden 5210 Glid-Guard Tank & Structural Primer 5205/5206/5207 at 2.0 mil DFT.

4. System No. 3 field touch-up shall be the same material as the shop primer.

5. System No. 3 finish shall be two (2) coats of one of the following, or equal:

   a. Induron Armorguard Epoxy at 3.0 to 5.0 mils DFT per coat

   b. Tnemec Series 1028Enduratone at 2.0 mils DFT per coat.

   c. Porter I.A.-24 Semi-Gloss at 1.5 mils DFT per coat.

   d. Glidden Ultra Hide Alkyd Semi-Gloss Enamel No. UH8000 at 1.5 mils DFT per coat.

D. System No. 4

1. System No. 4 shall be used for interior, galvanized, ferrous metals not subject to immersion, frequent splashing or condensation, including but not limited to the following:

   a. Interior galvanized piping, except piping subject to condensation.

   b. Interior galvanized conduit, mechanical equipment, control panels, miscellaneous metal, etc. without a factory-applied final finish.

   c. Metal decking

2. System No. 4 surface preparation shall be SP M1. The surface must be degreased and abraded, minimum 1.0 mil profile.

3. System No. 4 field clean-up includes removing all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC-

SP 1 Solvent Cleaning.

4. System No. 4 primer shall be one coat of one of the following, or equal:

   a. Induron Vinyl Wash Primer at 0.5 to 1.0 mils DFT

   b. Tnemec Series 66HS Hi-Build Epoxoline at 2-4 mils dft.

   c. Porter 1799 V.C.-17 Wash Prime at 0.5 mil DFT.

   d. Glidden Glid-Guard Tank and Structural Primer no. 5205/5206/5207 at 2.0 mils DFT.

5. System No. 4 finish coat shall be two (2) coats of one of the following, or equal:

   a. Induron Indurethane 5500 Gloss Enamel at 1.5 to 2.5 mils DFT per coat.

   b. Tnemec Series 1028 Enduratone at 2.0 mils DFT per coat.

   c. Porter I.A.-24 Semi-Gloss at 1.5 mils DFT per coat.

   d. Glidden Ultra Hyde Alkyd Semi-Gloss Enamel UH8000 at 1.5 mils DFT per coat.

E. System No. 5

1. System No. 5 shall be used for interior, non-galvanized ferrous metals subject to condensation, including but not limited to the following:

   a. Interior liquid process and water piping.

   b. Chemical piping.

   c. Air intake piping.

2. System No. 5 surface preparation shall be SP 6

3. System No. 5 shop primer shall be one coat of one of the following, or equal:

   a. Induron P-14 Armorguard Primer at 3.0 to 5.0 mils DFT

   b. Tnemec 37H-77 Chem-Prime Universal Primer at 2.0-3.5 mils DFT or Tnemec N69 Hi-Build Eposoline II at 3.0-5.0 mils DFT.

c. Porter 4300 M.C.R.-43 Epoxy Primer at 2.0 mils DFT.

d. Glidden 5251/5252 Glid-Guard Epoxy Chromate Metal Primer at 1.5 mils DFT.

4. System No. 5 field touch-up shall be the same material as the shop primer.

5. System No. 5 finish shall be two (2) coats of one of the following, or equal:

a. Induron Armorguard Epoxy at 3.0 to 5.0 mils DFT per coat.

b. Tnemec Series 66 Epoxoline at 2.5 mils DFT per coat.

c. Porter M.C.R.-43 High Build Semi-Gloss Epoxy at 3.0 mils DFT per coat.

d. Glidden 5250/5242 Glid-Guard Epoxy Chemical Resistant Finish at 3.0 mils DFT per coat.

F. System No. 6

1. System No. 6 shall be used for interior, galvanized, ferrous metals subject to condensation, including but not limited to interior galvanized liquid process and water piping.

2. System No. 6 surface preparation shall be SP M1 or SP 7. Must sweep blast with a minimum 1.0 mil blast profile.

3. System No. 6 field clean-up includes removing all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC-SP 1 Solvent Cleaning.

4. System No. 6 primer shall be one coat of one of the following, or equal:

a. Induron Vinyl Wash Primer 0.5 to 1.0 mils DFT

b. Tnemec: Series 66 at 2.5 mils DFT.

c. Porter 45 Galvaprep at 1000 square feet per gallon.

d. Glidden 5251/5252 Glid-Guard Epoxy Chromate Metal Primer at 1.5 mils DFT.

5. System No. 6 finish shall be two (2) coats of one of the following, or equal:

a. Induron Armorguard Epoxy at 3.0 to 5.0 mils DFT per coat.

b. Tnemec Series 66 Hi-Build Epoxoline at 2.5 mils DFT per coat.

c. Porter M.C.R.-43 High Build Semi-Gloss Epoxy at 3.0 mils DFT per coat.

d. Glidden 5250/5242 Glid-Guard Epoxy Chemical Resistant Finish at 3.0 mils DFT per coat.

G. System No. 7

1. System No. 7 shall be used for non-galvanized, ferrous metals subject to immersion or frequent splashing, including but not limited to the following:

a. Submerged piping and piping subject to splashing.

b. Submersible pumps.

c. Submerged miscellaneous metal, equipment, etc. without a factory-applied final finish.

2. System No. 7 surface preparation shall be SP 10.

3. System No. 7 shop primer shall be one coat of one of the following, or equal:

a. Induron P-14 Armorguard Primer at 3.0 to 5.0 mils DFT.

b. Tnemec Series N69 Hi-build Epoxoline II at 2.5 – 5.0 mils DFT

c. Porter 4300 M.C.R.-43 Epoxy Primer at 2.0 mils DFT.

d. Glidden Glid-Guard Corrosion Resistant H.S. Epoxy No. 5465 Series at 3.0 mils DFT.

4. Field touch-up shall be the same material as shop primer.

5. Finish shall be two (2) coats of one of the following, or equal:

a. Induron Armorguard Epoxy at 3.0 to 5.0 mils DFT per coat.

b. Tnemec Series N69 Hi-Build Epoxoline II at 4.0 - 6.0 mils DFT per coat. .

c. Porter 24770/24771 Tank Lining at 3.0 mils DFT per coat.

d. Glidden Glid-Guard Chemical Resistant Epoxy No. 5250/5242 at

5.0 mils DFT per coat.

H. System No. 8

1. System No. 8 shall be used for galvanized, ferrous metals subject to immersion or frequent splashing, including but not limited to the following:

   a. Submerged galvanized piping and piping subject to splashing.

   b. Submerged galvanized conduit, miscellaneous metal, equipment, etc. without a factory-applied final finish.

2. System No. 8 surface preparation shall be SP M1 and SP 7. Abrasive blast with a minimum SSPC SP10 with a 1.5 minimum blast profile.

3. System No. 8 field clean-up includes removing all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC-SP 1 Solvent Cleaning.

4. System No. 8 primer shall be one coat of one of the following, or equal:

   a. Induron Vinyl Wash Primer at 0.5 to 2.0 mils DFT.

   b. Tnemec: Series 66 at 2.5 mils DFT or Tnemec Series N69

   c. Porter 4300 M.C.R.-43 Epoxy Primer at 2.0 mils DFT.

   d. Glidden Glid-Guard Corrosion Resistant H.S. Epoxy Resistant No. 5465 Series at 5.0 mils DFT.

5. System No. 8 finish shall be two (2) coats of one of the following, or equal:

   a. Induron Armorguard Epoxy at 3.0 to 5.0 mils DFT per coat.

   b. Tnemec Series 66 Epoxoline at 4.0-6.0 mils DFT per coat.

   c. Porter 24770/24771 Tank Lining System at 3.0 mils DFT per coat.

   d. Glidden 5250/5242 Glid-Guard Epoxy Chemical Resistant Finish (Double Build) at 5.0 mils DFT per coat.

I. System No. 9

1. System No. 9 shall be used for interior, exterior, and submerged concrete, except concrete requiring a tile-like epoxy finish, including but not limited to

the following:

a. Interior cast-in-place concrete walls, except washroom walls.

b. Pipe gallery walls and ceiling.

c. Submerged concrete, where indicated to be painted.

2. System No. 9 surface preparation shall be SP C2 or SP C3 (horizontal surfaces only).

3. System No. 9 filler shall be one coat of one of the following, or equal (May be deleted if concrete has rubbed finish. Delete filler for all submerged concrete), for interior walls, non-immersion.:

a. Tnemec Series 54 Masonry filler.

b. Porter 895 Unifill at 100 square feet per gallon.

c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

d. Induron Polyfill Epoxy Block Filler at 100 sq. ft. per gallon.

4. System No. 9 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 66 Epoxoline at 5.0 mils DFT per coat.

b. Porter 24770/24771 Tank Lining System at 3.0 mils DFT per coat.

c. Glidden 5250/5242 Glid-Guard Epoxy Chemical Resistant Finish (Double Build) at 5.0 mils DFT per coat.

d. Induron Armorguard SG Epoxy at 3.0 to 5.0 mils DFT per coat.

J. System No. 10

1. System No. 10 shall be used for interior concrete requiring a tile-like epoxy finish, including but not limited to interior washroom walls.

2. System No. 10 surface preparation shall be SP C2.

3. System No. 10 filler shall be one coat of one of the following, or equal (May be deleted if concrete has rubbed finish):

a. Tnemec 1254 Epoxoblock at 100 square feet per gallon.

b. Porter 895 Unifill at 100 square feet per gallon.

c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

d. Induron Polyfill Epoxy Block Filler at 100 sq. ft. per gallon.

4. System No. 10 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 66HS Hi-Build Epoxoline at 4.0 mils DFT per coat.

b. Porter: First coat, Porter M.C.R.-43 High Build Epoxy at 5.0 mils DFT. Second coat, Porter M.C.R.-43 Gloss Epoxy at 2.0 mils DFT.

c. Glidden 5550 Series Glid-Guard Glid-Tile Epoxide Coating at 6.0 mils DFT per coat.

d. Induron Perma-Clean II at 4.0 to 6.0 mils DFT per coat.

K. System No. 11

1. System No. 11 shall be used for interior concrete requiring a matte finish, including but not limited to precast concrete ceilings, beams and columns.

2. System No. 11 surface preparation shall be SP C2.

3. System No. 11 filler shall be one coat of one of the following, or equal:

a. Tnemec Masonry Filler at 80 square feet per gallon.

b. Porter 895 Unifill at 100 square feet per gallon.

c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

d. Induron AC 202 Acrylic Block Filler at 75 sq. ft. per gallon.

4. System No. 11 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1026 Enduratone at 2.5 mils DFT per coat..

b. Induron AC 230 Acrylic Eggshell at 2.0 mils DFT per coat.

c. Porter 16 Series Acrylic Industrial Coating at 2.0 mils DFT per coat.

d. Glidden 3525 Series Spred Glide-On Masonry Paint at 1.5 mils DFT per coat.

L. System No. 12

1. System No. 12 shall be used for exterior concrete requiring a matte finish.

2. System No. 12 surface preparation shall be SP C2.

3. System No. 12 filler shall be one coat of one of the following, or equal (May be deleted if concrete has rubbed finish):

   a. Tnemec 1254—Inorganic hybrid water based Epoxy Masonry Surfacer at 100 – 150 square feet per gallon.

   b. Porter 895 Unifill at 100 square feet per gallon.

   c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

   d. Induron primer not needed

4. System No. 12 finish shall be two (2) coats of one of the following, or equal:

   a. Tnemec 1026 Enduratone at 2.5 mils DFT per coat.

   b. Porter 16 Series Acrylic Industrial Coating at 2.0 mils DFT per coat.

   c. Glidden 3525 Series Spred Glide-On Masonry Paint at 1.5 mils DFT per coat.

   d. Induron AC 403 Acrylic Elastomeric at 6.0 mils DFT per coat.

M. System No. 13

1. System No. 13 shall be used for interior masonry, including but not limited to masonry walls, except washroom walls.

2. System No. 13 surface preparation shall be SP C1.

3. System No. 13 filler shall be one coat of one of the following, or equal:

   a. Tnemec 151 Elasto-Grip at 300 square feet per gallon or for CMU use Tnemec 1254 EpoxoBlock at 100 – 150 square feet per gallon

   b. Porter 895 Unifill at 100 square feet per gallon.

   c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per

gallon, or until pin hole free.

d. Induron Polyfill Epoxy Block Filler at 100 sq. ft. per gallon.

4. System No. 13 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 66 Hi-Build Epoxoline at 4.0 - 65.0 mils DFT per coat.

b. Porter M.C.R.-43 High Build Semi-Gloss Epoxy at 5.0 mils DFT per coat.

c. Glidden Epoxy Chemical Resistant No. 5240-50/5242 5.0 mils DFT.

d. Induron Armorguard Epoxy at 4.0 mils DFT per coat.

N. System No. 14

1. System No. 14 shall be used for masonry walls requiring a tile-like epoxy finish, including but not limited to interior washroom walls.

2. System No. 14 surface preparation shall be SP C1.

3. System No. 14 filler shall be one coat of one of the following, or equal:

a. Tnemec 1254-EpoxoBlock at 100 - 150 square feet per gallon.

b. Porter 895 Unifill at 100 square feet per gallon.

c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

d. Induron Polyfill Epoxy Block Filler at 100 sq. ft. per gallon.

4. System No. 14 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 66HS Hi-Build Epoxoline at 4.0 mils DFT per coat.

b. Porter: First coat, Porter M.C.R.-43 High Build Epoxy at 5.0 mils DFT. Second coat, Porter M.C.R.-43 Gloss Epoxy at 2.0 mils DFT.

c. Glidden 5550 Series Glid-Guard Glid-Tile Epoxide Coating at 6.0 mils DFT per coat.

d. Induron Perma-Clean II at 4.0 mils DFT per coat.

O. System No. 15

1. System No. 15 shall be used for exterior masonry requiring a matte finish.

2. System No. 15 surface preparation shall be SP C2.

3. System No. 15 filler shall be one coat of one of the following, or equal:

   a. Tnemec 1254–EpoxoBlock inorganic hybrid water-based Epoxy Masonry Surfacer at 100- 150 square feet per gallon..

   b. Porter 895 Unifill at 100 square feet per gallon.

   c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

   d. Induron primer not needed.

4. System No. 15 finish shall be two (2) coats of one of the following, or equal:

   a. Tnemec Series 1026 Enduratone at 2.5 mils DFT per coat.

   b. Porter 16 Series Acrylic Industrial Coating at 2.0 mils DFT per coat.

   c. Glidden 3525 Series Spred Glide-On Masonry Paint at 1.5 mils DFT per coat.

   d. Induron AC 403 Acrylic Elastomeric at 6.0 mils DFT per coat.

P. System No. 16

1. System No. 16 shall be used for interior masonry requiring a matte finish.

2. System No. 16 surface preparation shall be SP C2.

3. System No. 16 filler shall be one coat of one of the following, or equal:

   a. Tnemec 54-561 Modified Epoxy Masonry Filler at 80 square feet per gallon.

   b. Porter 895 Unifill at 100 square feet per gallon.

   c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

   d. Induron AC 202 Acrylic Block Filler at 75 sq. ft. per gallon.

4. System No. 16 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1026 Enduratone at 2.5 mils DFT per coat.

b. Porter 16 Series Acrylic Industrial Coating at 1.1 mils DFT per coat.

c. Glidden 3525 Series Spred Glide-On Masonry Paint at 1.5 mils DFT per coat.

d. Induron AC 230 Acrylic Eggshell at 2.0 mils DFT per coat.

Q. System No. 17

1. System No. 17 shall be used for the following interior surfaces:

a. Drywall

b. Plaster

c. Stucco

2. System No. 17 surface preparation shall be SP P1 (Drywall) or SP P2 (Plaster and Stucco).

3. System No. 17 primer shall be one coat of one of the following, or equal:

a. Tnemec 51-792 PVA Sealer at 1.5 mils DFT.

b. Porter 767 Latex Primer Sealer at 3.0 mils DFT.

c. Glidden 5019 Ultra-Hide PVA Primer-Sealer at 1.0 mils DFT.

d. Induron AC 402 Acrylic Masonry Sealer at 1.0 mils DFT.

4. System No. 17 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1026 Enduratone at 2.5 mils DFT per coat.

b. Porter 16 Series Acrylic Industrial Coating at 2.0 mils DFT per coat.

c. Glidden 3400 Series Spred Satin Latex Wall Paint at 1.4 mils DFT per coat.

d. Induron AC 230 Acrylic Eggshell at 2.0 mils DFT per coat.

R. System No. 18

1. System No. 18 shall be used for the following exterior surfaces:

a. Concrete columns and beams

b. Stucco

2. System No. 18 surface preparation shall be SP C2.

3. System No. 18 filler shall be one coat of one of the following, or equal:

a. Tnemec 1254 EpoxoBlock Hybrid Waterbased Epoxy Masonry Surfacer at 100 – 150 square feet per gallon.

b. Porter 895 Unifill at 100 square feet per gallon.

c. Glidden Ultra Hide Latex Block Filler No. 5317 at 75 square feet per gallon, or until pin hole free.

d. Induron primer not needed.

4. System No. 18 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1026 Enduratone at 2.5 mils DFT per coat.

b. Porter 16 Series Acrylic Industrial Coating at 2.0 mils DFT per coat.

c. Glidden 3525 Series Spred Glide-On Masonry Paint at 1.5 mils DFT per coat.

d. Induron AC 403 Acrylic Elastomeric at 6.0 mils DFT per coat.

S. System No. 20

1. System No. 20 shall be used for exterior wood surfaces requiring a semi-gloss finish.

2. System No. 20 surface preparation shall be SP W1.

3. System No. 20 primer shall be one coat of one of the following, or equal:

a. Tnemec 10-99W Tnemec Prime at 2.0 mils DFT.

b. Porter 515 Acrylic Bonding Primer at 1.5 mils DFT.

c. Glidden Ultra Hide Oil/Alkyd Exterior Primer UH-450.

d. Induron AC 301 Wood Primer at 1.5 mils DFT.

4. System No. 20 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1029 Enduratone at 2.0 mils DFT per coat.

b. Porter 1660 Series Acrylic Enamel at 2.5 mils DFT per coat.

c. Glidden Spred Ultra Gloss House Paint No. 6600 Series at 1.4 mils DFT per coat.

d. Induron Armorlux 2500 at 1.5 mils DFT per coat.

T. System No. 21

1. System No. 21 shall be used for interior wood surfaces requiring a gloss finish.

2. System No. 21 surface preparation shall be SP W1.

3. System No. 21 primer shall be one coat of one of the following, or equal:

a. Tnemec 10-99W Tnemec Primer at 2.5 mils DFT.

b. Porter 2429 I.A.-24 Undercoat at 2.0 mils DFT.

c. Glidden Ultra Hide Alkyd Interior Enamel Undercoater No. UH400 at 1.5 mils DFT.

d. Induron AC 301 Wood Primer at 1.5 mils DFT.

4. System No. 21 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 2 Tneme-Gloss at 1.5 mils DFT per coat.

b. Porter I.A.-24 Gloss Finish at 1.5 mils DFT per coat.

c. Glidden 4550 Series Glid-Guard Alkyd Industrial Enamel at 2.0 mils DFT per coat.

d. Induron Armorlux 2500 at 1.5 mils DFT per coat.

U. System No. 22

1. System No. 22 shall be used for interior wood surfaces requiring a semi-gloss finish.

2. System No. 22 surface preparation shall be SP W1.

3. System No. 22 primer shall be one coat of one of the following, or equal:

a. Tnemec 10-99W Tnemec Primer at 2.5 mils DFT.

b. Porter 2429 I.A.-24 Undercoat at 2.0 mils DFT.

c. Glidden Ultra Hide Alkyd Interior Enamel Undercoater UH400 at 1.5 mils DFT.

d. Induron AC 301 Wood Primer at 1.5 mils DFT.

4. System No. 22 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1029 Enduratone at 2.0 mils DFT per coat.

b. Porter I.A.-24 Semi-Gloss at 1.5 mils DFT per coat.

c. Glidden Ultra Hide Alkyd Semi-Gloss Enamel UH-8000 at 1.5 mils DFT per coat.

d. Induron AC 240 Acrylic Semi-Gloss at 2.0 mils DFT per coat.

V. System No. 23

1. System No. 23 shall be used for interior wood surfaces requiring a low-sheen finish.

2. System No. 23 surface preparation shall be SP W1.

3. System No. 23 primer shall be one coat of one of the following, or equal:

a. Tnemec 10-99W Tnemec Primer at 2.5 mils DFT.

b. Porter 515 Acrylic Bonding Primer at 1.5 mils DFT.

c. Glidden Ultra Hide Alkyd Interior Enamel Undercoater UH-400 at 1.5 mils DFT.

d. Induron AC 301 Wood Primer at 1.5 mils DFT.

4. System No. 23 finish shall be two (2) coats of one of the following, or equal:

a. Tnemec Series 1026 Enduratone at 2.5 mils DFT per coat.

b. Porter 16 Series Industrial Coating at 2.0 mils DFT per coat.

c. Glidden Ultra Hide Alkyd Eggshell Enamel No. 5000 Series.

d. Induron AC 230 Acrylic Eggshell at 2.0 mils DFT per coat.

W. System No. 24 - ***Not Used***

1. System No. 24 shall be used for insulated and canvas-wrapped piping.

2. System No. 24 surface preparation shall be general cleaning.

3. System No. 24 primer shall be one coat of one of the following, or equal:

   a. Tnemec 51-792 PVA Sealer at 1.5 mils DFT.

   b. Porter 767 Latex Primer Sealer at 3.0 mils DFT.

   c. Glidden 5116 Insul-Aid Vapor Barrier Primer-Sealer at 1.7 mils DFT.

   d. Induron AC 210 Acrylic Primer at 1.5 mils DFT.

4. System No. 24 finish shall be two (2) coats of one of the following, or equal:

   a. Tnemec Series 23 Enduratone at 2.0 mils DFT per coat.

   b. Porter I.A.-24 Semi-Gloss at 1.5 mils DFT per coat.

   c. Glidden Ultra Hide Alkyd Semi-Gloss Enamel UH-8000 at 1.5 mils DFT per coat.

   d. Induron AC 230 Acrylic Eggshell at 1.5 mils DFT per coat.

X. System No. 25

1. System No. 25 shall be used for metal surfaces.

2. System No. 25 surface preparation shall be SP 10.

3. System No. 25 shop primer shall be one coat of one of the following, or equal:

   a. Induron PE-54 Primer at 3.0 to 5.0 mils DFT.

   b. Tnemec Series 66HS Hi-Build Epoxoline at 2- 5 mils dft.

   c. Porter 4300 M.C.R.-43 Epoxy Primer at 2.0 mils DFT.

   d. Glidden Glid-Guard Corrosion Resistant H.S. Epoxy No. 5465 Series at 3.0 mils DFT.

4. System No. 25 field touch-up shall be one of the following, or equal:

   a. Induron Ruff Stuff 2100 Coal Tar Epoxy

   b. Tnemec Series 66HS Hi-Build Epoxoline at 2- 5 mils dft.

c. Porter 4300 M.C.R.-43 Epoxy Primer.

d. Glidden Glid-Guard Corrosion Resistant H.S. Epoxy No. 5465 Series at 3.0 mils DFT.

5. System No. 25 finish shall be two (2) coats of one of the following, or equal:

a. Induron Ruff Stuff 2100 Coal Tar Epoxy at 8.0 mils DFT per coat; apply second coat within 90 days of first coat.

b. Tnemec 46-413 Tneme-Tar at 8.0 mils DFT per coat; apply second coat within 96 hours of first coat.

c. Porter 7013 Tarset C-200 Black at 8.0 mils DFT per coat; apply second coat within 24 hours of first coat.

d. Glidden 5270-1 Glid-Guard Coal Tar Epoxy Finish at 8.0 mils DFT per coat; apply second coat within 24 hours of first coat.

Y. System No. 26

1. System No. 26 shall be used for concrete surfaces, including but not limited to the following:

a. Submerged concrete (EQ basins, Biological Process basins, Sludge Hold Tanks, Chlorine Contact Chambers, etc.)

b. All precast structures or cast-in-place concrete below grade (interior and exterior)

2. System No. 26 surface preparation shall be SP C1.

3. System No. 26 finish shall be two (2) coats of one of the following, or equal:

a. Induron Ruff Stuff 2100 Coal Tar Epoxy at 8.0 mils DFT per coat; apply second coat within 90 days of first coat.

b. Tnemec 46-413 Tneme-Tar at 9.0 mils DFT per coat; apply second coat within 96 hours of first coat.

c. Porter 7013 Tarset C-200 Black at 8.0 mils DFT per coat; apply second coat within 24 hours of first coat.

d. Glidden 5270-1 Glid-Guard Coal Tar Epoxy Finish at 8.0 mils DFT

per coat; apply second coat within 24 hours of first coat.

Z. System No. 27

1. System No. 27 shall be used for steel surfaces in potable water immersion.

2. System No. 27 surface preparation shall be SP 10 Near White Metal Blast. A minimum 1.5 mil blast profile is required.

3. System No. 27 shop primer shall be one coat of the following system or equal:

   a. Induron PE-54 Primer at 3.0 □ 5.0 mils DFT.

   b. Tnemec Series N140 Pota-Pox Plus at 3.0 – 5.0 mils dft. Use alternating colors.

4. System No. 27 field touch-up shall be one coat of the following system or equal:

   a. Induron PE-54 Primer at 3.0 □ 5.0 mils DFT.

   b. Tnemec Series N140 Pota-Pox Plus at 3.0 – 5.0 mils dft. Use alternating colors.

5. System No. 27 finish shall be two full coats of the following system or equal:

   a. Induron PE-54 Int./Finish at 3.0 □ 5.0 mils DFT per coat.

AA. System No. 28

1. System No. 28 shall be used for concrete surfaces in potable water immersion.

2. System No. 28 surface preparation shall be SP C1.

3. System No. 28 shop primer shall be one coat of the following system or equal:

   a. Induron PE-54 Primer at 3.0 to 5.0 mils DFT.

   b. Tnemec Series N140 Pota-Pox Plus at 3.0 – 5.0 mils dft. Use alternating colors.

4. System No. 28 field touch-up shall be one coat of the following system or

equal:

a. Induron PE-54 Primer at 3.0 to 5.0 mils DFT.

b. Tnemec Series N140 Pota-Pox Plus at 3.0 – 5.0 mils dft. Use alternating colors.

5. Finish: Two full coats of the following system or equal:

a. Induron PE-54 Int./Finish at 3.0 to 5.0 mils DFT per coat.

b. Tnemec Series N140 Pota-Pox Plus at 3.0 – 5.0 mils dft. Use alternating colors.

BB. System No. 29

1. System No. 29 shall be used for all non-painted, exposed concrete flooring surfaces.

2. System No. 29 surface preparation shall be SP C1

3. System No. 29 shall be three coats of Sonneborn “Kure-N-Seal”, Euclid Chemical Co. “Surfhard”, Lambert Corp. “Solidus” or Tnemec Chemprobe Series 629 CT Densifyer applied per the manufacturer’s installation instructions, or an approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. All painting shall be done in strict accordance with the recommendations of the manufacturer and shall be performed in a manner satisfactory to the Owner/Engineer.

B. All recommendations of the paint manufacture in regard to mixing, applying, thinning and curing as well as the health and safety of the workers shall be followed.

C. Dry film thickness for masonry is approximate for application to a smooth surface.

D. Sequence painting to ensure work area is dust free.

3.02 MIXING

A. Exercise care to keep fire hazards to a minimum. Provide an approved hand fire extinguisher near each paint storage and mixing area. No oily waste, rags, or painting equipment shall be left scattered throughout the premises.

B. Mix coatings in accordance with manufacturer's instructions. Colors shall be thoroughly mixed with no streaks or separation of color. Do not add thinners, driers or other additives except as recommended by the coating manufacturer. Do not incorporate in the coating any thinners or solvents used for cleaning brushes or equipment.

C. Protect all adjacent areas against damage and leave storage and mixing areas clean at the completion of painting.

3.03 ACCEPTANCE OF SURFACES

A. Inspect all surfaces and adjoining work and report to the E/A in writing any existing unsatisfactory conditions. No painting work shall be started until the unsatisfactory conditions are remedied.

B. Commencement of surface preparation and painting shall constitute the acceptance of existing conditions and any defects appearing in the painting work thereafter shall be by the Contractor at no additional cost.

3.04 PROTECTION OF ADJACENT SURFACES

A. Provide necessary protection for completed work and all adjoining surfaces. Provide temporary closures as required to prevent circulation of dust from adjacent areas where other work is in progress. Where it is necessary to remove existing protection of work of others, such protection shall be fully replaced.

B. Locate and protect all existing utilities, structures, or appurtenances.

3.05 VENTILATION

A. Provide adequate ventilation for safe application and for proper drying of coatings on interior surfaces. Ensure solvent vapors are released during and after application of coatings. Remove vapors by exhausting air from the lowest portions of tanks or enclosed spaces and keep tops open and clear. During coating application in enclosed areas the capacity of ventilating fans shall be at least 300

cfm per gallon of coating applied per hour. Provide continuous forced ventilation at a rate of at least one complete air change per 4 hours for at least 7 days after coating application is completed.

3.06 GENERAL SURFACE PREPARATION REQUIREMENTS

A. Prepare all surfaces in accordance with the coating manufacturer's instructions and as specified. Surfaces shall be uniform texture, dry, and free from dust, grit, oil, grease, or any material which will adversely affect adhesion or appearance of the coating. Rough edges of metal, weld seams and sharp edges from scaffold lugs shall be ground to a curve.

B. Surfaces that have been cleaned, pretreated, and/or otherwise prepared for painting shall be given a coat of the first-coat material as soon as practicable prior to any deterioration of the prepared surface.

C. Hardware, accessories, plates, fixtures, and similar items in contact with coated surfaces shall be removed, masked, or otherwise protected prior to surface preparation and painting operations.

D. Exposed nails and other ferrous metals on surfaces to be coated shall be spot-primed with a metal primer compatible with the finish.

3.07 SURFACE PREPARATION

A. Surface Preparation SP 3 - Power Tool Cleaning

1. Remove all oil and grease from surface. Power tool clean the surface removing all loose mill scale, loose rust, loose paint and other detrimental foreign matter by the methods outlined in the SSPC SP 3. Feather out edges of chipped or abraded areas to prevent flaws from showing through finish coats.

2. The cleaned surface shall be primed as soon as possible and before any rusting of the surface occurs.

B. Surface Preparation SP 6 - Commercial Blast Cleaning

1. Remove all oil and grease from the surface. Blast clean surface to a Commercial Finish, removing mill scale, dirt, rust, and foreign matter by the methods outlined in SSPC SP 6. Two thirds of each square inch of surface

area shall be free of all visible residues.

2. Blasting shall be done with centrifugal wheel or compressed air blast using either steel grit or flint silica sand. Abrasive should provide a profile depth of 1.0 to 2.0 mils. Steel Grit #G-80 or flint silica sand 20-50 mesh is recommended to obtain proper profile depth. Remove all dust and sand by vacuuming.

3. The blast cleaned surface shall be primed as soon as possible and before any rusting of the surface occurs.

C. Surface Preparation SP 7 - Brush-Off Blast : Prepare metal as outlined in SSPC SP 7 to provide for proper adhesion of coating.

D. Surface Preparation SP l0 - White Blast Cleaning

1. Steel surfaces shall be dry and clean. Remove all grease, oils and contaminants with rags soaked in toluol or xylol. Solvent Clean all surfaces per SSPC-SP 1 Solvent Cleaning.

2. Remove all weld spatter. Grind all rough welds and sharp edges to a smooth rounded contour. Blast clean the surface to a Near White Metal finish, removing nearly all mill scale, rust, rust-scale, paint or foreign matter by the recommended methods outlined in SSPC SP l0. At least 95 percent of each square inch shall be free of all visible residues and staining.

3. Blasting shall be done with centrifugal wheel or compressed air blast nozzles using either steel grit or flint silica sand. Abrasive should provide profile depth of l.0 to 2.0 mils or that as specified by the coating manufacturer. Remove all dust and sand by vacuuming.

4. The blast cleaned surface should be primed as soon as possible and before any rusting of the surface occurs.

E. Surface Preparation SP C1 - General Cleaning: Allow concrete and masonry to cure in place for 28 days. Remove all dirt, dust, form oil, curing compounds, grease stains, or efflorescence from surfaces and roughen as required to provide good adhesion of coatings. If washing of the surface is required, use tri-sodium phosphate solution followed by a clean water rinse. Fill all minor holes to produce

uniform surface textures.

F. Surface Preparation SP C2 - Sweep Sand Blasting

1. Concrete surfaces must be clean, dry and free of existing coatings. Cure new concrete a minimum of 28 days. Fill and seal structural cracks and defects.

2. Concrete shall be cleaned and etched by sweep sandblasting (brush-off blast) so the surface is grainy to the touch. All dust or foreign matter shall be removed by vacuuming.

G. Surface Preparation SP C3 - Acid Etching (Horizontal Surfaces Only)

1. Concrete surfaces must be clean and dry. Cure new concrete a minimum of 28 days. Remove all dirt, dust, grease, oil and other contaminants from surface.

2. Etch concrete surface with l5 to 20 percent muriatic acid. Thoroughly coat the concrete with solution applied with a mop or brush. When foaming stops, thoroughly neutralize with clear water to remove soluble salts. Test the rinse water with litmus paper to verify the neutralization.

3. After etching, the surface shall be "grainy" to the touch; if not, repeat the treatment.

4. Permit surface to thoroughly dry a minimum of 72 hours before coating, while maintaining the cleanliness of the surface.

H. Surface Preparation SP M1 - Solvent Cleaning: Non-ferrous and galvanized ferrous surfaces scheduled to receive paint shall be solvent cleaned to remove all oils, salts, and contaminants prior to application of pretreatments or primers.

I. Surface Preparation SP P1 – Drywall: Fill all surface irregularities with spackling compound and sand to a smooth level surface prior to applying finish. Care shall be exercised to avoid raising nap on the paper.

J. Surface Preparation SP P2 - Plaster and Stucco: Rake cracks, scratches and abrasions deeply. Soak with water and fill with patching plaster or spackling compound. Treat with aqueous solution of zinc sulphate, 4 lbs. to l gallon of water. Add to solution enough phenophthalein to act as a color warning of alkali. Allow to

dry for 3 days. Remove loose crystals before coating.

K. Surface Preparation SP W1 – Wood: Sandpaper to a smooth even surface and vacuum or dust off. Treat all knots and sap spots with mineral spirits and, when dry, touch up with an approved sealer. Subsequent to priming and staining, thoroughly fill holes and cracks with plastic wood filler for transparent finishes and putty for painted wood. Unless otherwise approved, paint only when the moisture content of the wood is below l2 percent. Do not apply primer or sealer to wood in areas where cement, mortar, or plaster is not thoroughly dry.

3.08 APPLICATION

A. All work shall be performed by skilled painters. Surfaces shall be free of drops, ridges, waves, laps and brush marks. Edges of paint adjoining other colors or materials shall be sharp and true.

B. Do not apply coatings in temperatures below 50 degrees F except where the manufacturer specifically allows for lower temperatures. No exterior painting shall be done during inclement weather when relative humidity exceeds 85%, the ambient temperature is within 5 degrees F of the Dew Point or under conditions identified by the manufacturer as unsuitable.

C. The average rate of application shall not exceed the theoretical rate of coverage recommended by the coating manufacturer for the type of surface involved, less an allowance for losses. Average DFT shall not be less than thickness set forth under Painting Systems. Not more than l0-20% of points inspected may be less than 90% of the specified thickness. Deficiencies shall be corrected by application of additional coating.

D. Each coat shall be uniform in coverage and color. Successive coats shall perceptibly vary in color. Each coat shall be carefully examined and faulty material, poor workmanship, holidays, damaged areas and other imperfections shall be touched up prior to applying succeeding coats. Comply with coating manufacturer's recommendations for drying time between coats.

E. Bottoms, sides and edges of doors shall receive same finish as faces of doors. If refitting of wood doors is done prior to final acceptance, refinish at no extra cost.

F. Incidental niches, recesses, passages, closets, etc., shall be finished to match

similar or adjacent spaces. Access doors, panels, convectors, grilles and similar items shall be coated the same color as adjacent work, except for non-ferrous metal or where otherwise directed by the E/A. Primed hardware shall be coated to match adjacent work to which they are attached.

G. In the event that the finished surfaces are not acceptable, completely refinish entire unit areas or sections as necessary in order to eliminate visible laps or other indications of repairs.

H. Mixing, thinning, pot life, application procedure, equipment, coverage, curing, re-coating, storage and number of coats shall be in accordance with coating manufacturer's instructions.

I. Avoid degradation and contamination of blasted surfaces, and avoid between coat contamination. Surfaces contaminated shall be cleaned before applying next coat. Method of cleaning contaminated surface shall be approved by the Engineer or owner□s representative.

J. Each application of material shall be worked into corners, crevices, joints, etc., and distributed evenly over flat surfaces. Spraying techniques that result in a uniform wet pattern shall be used and dry spraying should be avoided. Dry spray shall be removed prior to coating being applied.

K. All bolts, welds, sharp edges, and difficult access areas shall receive a primer brush coat or spray coat prior to primer spray application.

3.09 PIPE COLOR CODING

A. Coat all exposed piping, conduit and appurtenances to conform to a color code as approved by the E/A.

B. Submit for the E/A to approve a coating schedule for the color coding of exposed piping, conduit and appurtenances.

3.10 CLEAN-UP

A. At completion of the painting work, clean off all paint spots and other paint materials from surfaces where they are not intended to be. Remove from the premises all rubbish and accumulated material and leave the work in clean orderly condition, acceptable to the E/A. All cloths and waste that might constitute a fire

hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site and/or destroyed in an approved and legal manner.

3.11 DAMAGED COATINGS

A. Damaged coatings, pinholes, and holidays shall have edges feathered and repaired in accordance with the recommendations of the manufacturer, as approved by the Engineer.

B. All finish coats, including touch up and damage-repair coats shall be applied in a manner which will present a uniform texture and color-match appearance.

3.12 UNSATISFACTORY APPLICATION

A. If the item has an improper finish, color, or insufficient dry film thickness, the surface shall be cleaned and top coated with the specified material to obtain the specified color and coverage. Specific surface preparation information to be secured from the coatings manufacturer and the Engineer.

B. All visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications.

C. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection.

D. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.

E. Any repairs made on steel surfaces for immersion service shall be holiday detected in accordance with ASTM G 62 low voltage holiday detection. Areas found to have holidays shall be marked and repaired in accordance with the paint manufacturer's instructions. The Engineer shall be notified of time of testing so that he might be present to witness testing.

3.13 GUARANTEE AND ANNIVERSARY INSPECTION

A. All work shall be warranted for a period of one year from date of acceptance of the project.

B. The Owner will notify the Contractor at least 30 days prior to the anniversary date and shall establish a date for the inspection. Any defects in the coating system shall be repaired by the Contractor at no additional cost to the Owner. Should a failure occur to 25% of the painted surface, either interior or exterior, the entire surface shall be cleaned and painted in accordance with these specifications.

END OF SECTION

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, and varnishes.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:

1. Corrocaot: www.corrocoat.com
2. Sherwin-Williams Company: www.sherwin-williams.com.
3. PPG Paints: www.ppgpaints.com/sle.
4. Valspar Corporation: www.valsparpaint.com.

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including parged concrete coating.

1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex.

2.04 PRIMERS

B. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Alkali Resistant Water Based Primer.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Exterior Plaster and Stucco: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 COLOR SCHEDULE

A. Exposed Parged Coat: Color to match existing.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, and varnishes.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 09 91 13 - Exterior Painting.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

C. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:

1. Corrocaot: www.corrocoat.com
2. Sherwin-Williams Company: www.sherwin-williams.com.
3. PPG Paints: www.ppgpaints.com/sle.
4. Valspar Corporation: www.valsparpaint.com.
5. Primer Sealers: Same manufacturer as top coats.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission

Standards for Architectural Coatings.

b. Architectural coatings VOC limits of the State in which the Project is located.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete masonry units.

1. Two top coats and one coat primer.

2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.

a. Products:

1) Behr Marquee Interior Matte [No. 1450]. (MPI#138)

2) PPG Paints Pitt-Glaze WB1 Pre-Catalyzed Water-Borne Acrylic Epoxy, 16-510 Series, Semi-Gloss.

3) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)

4) Valspar Professional Interior Pre-Catalyzed Epoxy, No. 33400 Series, Semi-Gloss.

3. Primer: As recommended by top coat manufacturer for specific substrate.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:

1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.

2. Two top coats and one coat primer.

3. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.

a. Products:

1) PPG Paints Pitt-Glaze WB Water-Borne Acrylic Epoxy, 16-599 Series, Gloss.

2) Sherwin-Williams Pro Industrial Waterbased Catalyzed Epoxy, Gloss. (MPI

#115)

3) Substitutions: Section 01 60 00 - Product Requirements.

4. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Alkali Resistant Water Based Primer; MPI #3.

a. Products:

1) Behr Concrete and Masonry Bonding Primer [No. 880].

2) PPG Paints Perma-Crete Interior/Exterior Alkali Resistant Primer, 4-603 Series. (MPI #3)

3) Substitutions: Section 01 60 00 - Product Requirements.

2. Interior/Exterior Latex Block Filler; MPI #4.

a. Products:

1) Kilz Pro-X p50 Block Filler Primer.

2) PPG Paints Concrete Coatings Block Filler, 3010. (MPI #4)

3) Valspar Professional Block Filler, No. 589 Series. (MPI #4)

4) Substitutions: Section 01 60 00 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.

2. Prepare surface as recommended by top coat manufacturer.

F. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.

2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 COLOR SCHEDULE

A. All Interior Spaces: Paint to match existing standards or as directed by Owner or Architect.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.01 DESCRIPTION

Work Specified Herein and Elsewhere

A. Work under this Section includes:

1. Safety signs.
2. Engraved plastic laminate signs.
3. Dedication plaque.

B. Related work specified elsewhere includes:

Identification for Electrical Systems – 26 05 53

1.02 SUBMITTALS

A. Shop Drawings and Product Data

Submit shop drawings and product data for the products of this Section in compliance with Division 1.

B. Samples

Submit samples of plastic laminate for approval by the Engineer.

PART 2 PRODUCTS

2.01 SAFETY SIGNS

A. Provide safety signs as specified herein and as indicated on the Drawings. Safety signs shall comply with OSHA requirements Section 1910.145. Signs shall be 10" by 14" horizontal signs of minimum 20-gauge steel with a baked-on enamel finish. "Caution" signs shall be yellow and black. "Danger" signs shall be red and black.

B. Floor Load Caution Signs

1. Provide floor load caution signs where indicated and for the loads indicated on the Drawings. Provide a minimum of one floor load caution sign for each area or room on a structural slab.

2. Floor load caution signs shall be lettered as follows:

CAUTION

CAPACITY ____ LBS

FLOOR LOAD

PER SQUARE FOOT

C. Fire Extinguisher Sign

1. Provide location signs for all fire extinguishers both inside or outside the building.

2. Sign shall be lettered as follows:

FIRE EXTINGUISHER

D. Emergency Egress Identification Signs

1. Provide signs at all emergency egress openings and not readily identifiable secondary egress doors.

2. Signs shall be lettered as follows:

EMERGENCY EGRESS

KEEP AREA CLEAR

E. No Combustible Storage Signs

1. Provide signs in all mechanical, electrical and generator/fuel areas, including the exterior fuel tank location.

2. Signs shall be lettered as follows:

COMBUSTIBLE STORAGE

NOT PERMITTED

F. High Voltage Warning Signs

1. Provide signs on all doors leading to the electrical equipment room

2. Signs shall be lettered as follows:

DANGER – HIGH

VOLTAGE

G. No Smoking Signs

1. Provide signs on all doors leading into the building and adjacent to the exterior fuel storage area.

2. Signs to be lettered as follows:

NO SMOKING

H. Hearing Protection Required Signs

1. Provide signs on all doors leading into the building pump/generator area.

2. Signs to be lettered as follows:

HEARING PROTECTION

REQUIRED

I. Eye Wash area signs

1. Provide signs on interior of Chlorine Room indicating the eye wash area is outside and directly adjacent to the exit door from the Chlorine Room.

2. Provide sign directly adjacent to the Eye Wash area.

3. Signs to be lettered as follows:

a. Sign inside Chlorine Room:

EXIT TO EYE WASH AREA

b. Sign above Eye Wash Area:

EYE WASH AREA

KEEP AREA CLEAR

2.02 ROOM IDENTIFICATION SIGNS

A. Provide room identification signs on walls directly adjacent to doors entering specified rooms. Room identification signs shall be minimum 10” by 5” horizontal signs of 316 Stainless Steel.

B. Chlorine Storage Room sign

1. Provide signs on all doors leading to the Chlorine Storage Room.

2. Signs to be lettered as follows:

CHLORINE STORAGE ROOM

C. Electrical Equipment Room sign

1. Provide signs on all doors leading to the Electrical Equipment Room.

2. Signs to be lettered as follows:

ELECTRICAL EQUIPMENT ROOM

D. Pump/Generator Room Sign

1. Provide signs on all doors leading into the Pump/Generator Room.

2. Signs to be lettered as follows:

PUMP/GENERATOR ROOM

2.03 PUMP IDENTIFICATION SIGNS

A. Provide pump identification signs for each pump. The signs shall be numbered to coincide with the controls in the Electrical System and SCADA system. The signs shall be a minimum of 4” by 2” and mounted at the base of each pump.

2.04 ENGRAVED PLASTIC LAMINATE SIGNS

A. Provide engraved plastic laminate signs as follows:

1. Provide _____ signs _____ -inch by _____ -inch with _____ -inch high letters.

2. Provide _____ signs _____ -inch by _____ -inch with _____ -inch high letters.

3. Provide _____ signs _____ -inch by _____ -inch with _____ -_inch high letters.

B. Plastic laminate shall be 1/8" thick with face and core colors as selected by the Engineer. Color selection will be made from the supplier's standard colors. However, the supplier shall provide a minimum of 10 colors for the Engineer's consideration.

C. Engraved letters shall be machine cut evenly into the contrasting color core. Letter style shall be Helvetica Medium.

2.05 DEDICATION PLAQUE – N/A

PART 3 EXECUTION

3.01 INSTALLATION

Install identification devices in a permanent manner as approved by the Engineer.

END OF SECTION

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SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Accessories for toilet rooms.

B. Electrically operated paper towel dispensers.

C. Grab bars.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011.

F. ASTM C1036 - Standard Specification for Flat Glass; 2011.

G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Samples: Submit two samples of each accessory, illustrating color and finish.

D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Toilet Accessories:

1. Tork: www.torkusa.com
2. Excel Dryer Inc.: www.exceldryer.com
3. GOJO: gojo.com
4. AJW Architectural Products : www.ajw.com
5. ASI - American Specialties, Inc : www.americanspecialties.com.
6. Bradley Corporation : www.bradleycorp.com.

B. All items of each type to be made by the same manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Provide 4 keys for each accessory to Owner ; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666 , Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Type 304 or 316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

G. Adhesive: Two component epoxy type, waterproof.

H. Fasteners, Screws, and Bolts: Hot dip galvanized ; tamper-proof ; security type.

I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: No. 4 Brushed finish , unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456 , SC 2, satin finish , unless otherwise noted.

C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.

D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

F. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 TOILET ROOM ACCESSORIES

A. Toilet Paper Dispenser: Tork Twin Jumbo Bath Tissue Roll Dispenser, Article 247549A, Color: Black, SCC: 10073286622393. Surface mounted black plastic dispenser with 10” roll capacity .

B. Electric Hand Dryer: The Excel Dryer Inc. Model Xlerator XL-W

1. Cover: Zinc die cast

2. Finish: White painted

3. Mounting: Recess mounted to be ADA compliant with manufacturer’s standard ADA compliant recess kit – 40502.

4. Warranty: 5 years

C. Waste Receptacle: Stainless steel, freestanding style with swing top.

D. Automated Soap Dispenser: GOJO FMX-12 Dispenser – Black – SKU 5155-06 Soap Dispenser.

1. Minimum Capacity: 1250 mL

2. Mounting: Wall

3. Finish: Black Plastic

E. Air Freshener Dispenser: Wall-mounted, battery operated.

1. Products:

a. Georgia-Pacific Professional ; GP ActiveAire Brushed Stainless Powered Whole-Room Freshener Dispenser: www.blue-connect.com.

F. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.

1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.

2. Size: As indicated on drawings.

3. Frame: 0.05 inch (1.3 mm) angle shapes, with mitered and welded and ground corners , and tamperproof hanging system; No.4 finish.

4. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.

5. Fixed Tilt Mirrors: Minimum 3 inches (75 mm) tilt from top to bottom.

G. Grab Bars: Stainless steel, nonslip grasping surface finish.

1. Standard Duty Grab Bars:

a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.

b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.

c. Length and Configuration: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

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SECTION 10 44 13

FIRE EXTINGUISHERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2007.

B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 PERFORMANCE REQUIREMENTS

A. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.05 SUBMITTALS

A. Product Data: Provide extinguisher operational features.

B. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers, Cabinets and Accessories:

1. JL Industries, Inc: www.jlindustries.com.
2. Larsen's Manufacturing Co: www.larsensmfg.com.
3. Potter-Roemer: www.potterroemer.com.
4. Substitutions: See Section 01600 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

B. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.

1. Class 3-A:40-B:C.
2. Size 10.

2.03 FIRE EXTINGUISHER CABINETS

A. Metal: Formed primed steel sheet; 0.036 inch thick base metal.

B. Cabinet Configuration: Semi-recessed type.

1. Sized to accommodate accessories.

C. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.

D. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.

E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

C. Place extinguishers and accessories in cabinets or mount on brackets as noted on drawings.

END OF SECTION

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SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.04 SUBMITTALS

A. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.

2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.

4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.

   a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

   b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:

1. Comply with MFMA-4.

2. Channel Material:

a. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

D. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

G. Secure fasteners according to manufacturer's recommended torque settings.

H. Remove temporary supports.

END OF SECTION

SECTION 22 10 05

PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.

1. Sanitary sewer.

2. Domestic water.

1.02 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

C. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

D. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.

E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

F. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.

G. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

H. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

I. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.

J. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

K. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

L. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

M. NSF 61 - Drinking Water System Components - Health Effects; 2017.

N. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints: ASTM B32, alloy Sn95 solder.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B32, alloy Sn95 solder.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 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.

3.03 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 walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Provide access where valves and fittings are not exposed.

G. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

H. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

I. Sleeve pipes passing through partitions, walls and floors.

J. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3.04 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.

2. Plastic Piping:

a. All Sizes:

1) Maximum Hanger Spacing: 6 ft.

2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION

SECTION 22 10 06

PLUMBING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Floor drains.

B. Cleanouts.

C. Hose bibbs.

D. Hydrants.

E. Backflow preventers.

F. Water hammer arrestors.

1.02 SUBMITTALS

A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

B. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, None.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Josam Company: www.josam.com.
3. LATICRETE Inernational, Inc.; LATICRETE® HYDRO BAN® Linear Drain: www.laticrete.com.
4. LATICRETE Inernational, Inc.; LATICRETE® HYDRO BAN® Bonding Flange Drain: www.laticrete.com.
5. Noble Company; FreeStyle Linear Drain: www.noblecompany.com.
6. Zurn Industries, Inc: www.zurn.com.
7. Approved Equal.

B. Floor Drain (FD-2):

1. ASME A112.6.3; galvanized cast iron or stainless steel, two piece body with double drainage flange, weep holes, and round, adjustable round nickel bronze strainer with removable perforated sediment bucket.

2.03 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Josam Company: www.josam.com.
3. Zurn Industries, Inc: www.zurn.com.
4. Approved Equal.

B. Cleanouts at Exterior Surfaced Areas (CO-1):

1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas (CO-2):

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas (CO-3):

1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E. Cleanouts at Interior Finished Wall Areas (CO-4):

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

F. Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Watts Regulator Company: www.wattsregulator.com.
3. Zurn Industries, Inc: www.zurn.com.
4. Approved Equal.

B. Interior Hose Bibbs:

1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in conformance with ASSE 1011.

C. Interior Mixing Type Hose Bibbs:

1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with handwheels, and vacuum breaker in conformance with ASSE 1011.

2.05 BACKFLOW PREVENTERS

A. Manufacturers:

1. Conbraco Industries: www.apollovalves.com.

2. Watts Regulator Company: www.wattsregulator.com.

3. Zurn Industries, Inc: www.zurn.com.

4. Approved Equal.

B. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded bent outlet; assembled with two gate valves, strainer, and four test cocks.

2.06 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:

1. Conbraco Industries: www.apollovalves.com.

2. Watts Regulator Company: www.wattsregulator.com.

3. Zurn Industries, Inc: www.zurn.com.

4. Approved Equal.

B. Double Check Valve Assemblies:

1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.07 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.

2. Watts Regulator Company: www.wattsregulator.com.

3. Zurn Industries, Inc: www.zurn.com.

4. Approved Equal.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F (-73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

PART 3 EXECUTION

3.01 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 flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories.

H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

END OF SECTION

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SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.

B. Lavatories.

1.02 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings; 2012.

B. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.

C. NSF 61 - Drinking Water System Components - Health Effects; 2017.

D. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 GENERAL

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 TANK TYPE WATER CLOSETS

A. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, 16.5 inches high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.

1. Water Consumption: Maximum 1.6 gallons per flush.

2.03 LAVATORIES

A. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 22 by 18 inch minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.

B. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 1.5 GPM, indexed handles.

C. Accessories:

1. Chrome plated 17 gage, 0.0538 inch brass P-trap with clean-out plug and arm with escutcheon.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Install components level and plumb.

3.04 CLEANING

A. Clean plumbing fixtures and equipment.

3.05 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Insulation jackets.

1.02 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.04 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. Knauf Insulation: www.knaufusa.com.
2. Johns Manville Corporation: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. CertainTeed Corporation: www.certainteed.com.
5. Approved Equal.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' ('Ksi') value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
3. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:

F. Tie Wire: Annealed steel, 16 gage (1.5 mm).

2.03 GLASS FIBER, RIGID

A. Manufacturer:

1. Knauf Insulation: www.knaufusa.com.
2. Johns Manville Corporation: www.jm.com.
3. Owens Corning Corp: www.owenscorning.com.
4. CertainTeed Corporation: www.certainteed.com.
5. Approved Equal.

B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. 'K' ('Ksi') value: 0.24 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C518.

2. Maximum service temperature: 450 degrees F (232 degrees C).

3. Maximum Water Vapor Sorption: 5.0 percent.

4. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.

3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.

2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Lagging Adhesive:

a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square (2.45 kg/sq m).

C. Aluminum Jacket: ASTM B209 (ASTM B209M).

1. Thickness: 0.016 inch (0.40 mm) sheet.

2. Finish: Smooth.

3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

G. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 SCHEDULES

A. Combustion Air Duct:

1. Flexible Glass Fiber Duct Insulation: 1 inches thick.
2. Rigid Glass Fiber Duct Insulation: 1 inches thick.

B. Evaporative Condenser Intake and Exhaust:

C. Exhaust Ducts Within 10 ft (3 m) of Exterior Openings:

D. Exhaust Ducts Exposed to Outdoor Air:

E. Outside Air Intake Ducts:

F. Plenums:

G. Plenums (Cooling System):

H. Ventilation Equipment Casings:

I. Supply Ducts:

J. Supply Ducts From Fans to Vertical Ducts in Shafts (Cooling System):

K. Supply Ducts in Vertical Shafts (Cooling Systems):

L. Supply ducts After Terminal Boxes:

M. Return and Relief Ducts in Mechanical Rooms:

N. Ducts Exposed to Outdoors:

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

B. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

C. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:

1. Control system.
2. Major and minor equipment items.
3. Piping systems and equipment.
4. Ductwork and accessories.
5. Sound control devices.
6. Vibration control devices.
7. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

D. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - The HVAC Commissioning Process; 2012

1.03 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. DRAFT Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

1. System name.
2. List of devices.
3. Step-by-step procedures for testing each controller after installation, including:
    a. Process of verifying proper hardware and wiring installation.
    b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
    c. Process of performing operational checks of each controlled component.
    d. Plan and process for calibrating valve and damper actuators and all sensors.
    e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
5. Description of the instrumentation required for testing.
6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:

1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
2. Full as-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
    a. Floor.
    b. Room number.
    c. Room name.
    d. Air handler unit ID.
    e. Reference drawing number.
    f. Air terminal unit tag ID.
    g. Heating and/or cooling valve tag ID.
    h. Minimum air flow rate.
    i. Maximum air flow rate.
5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.

9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    a. Sequences of operation.
    b. Control drawings.
    c. Points lists.
    d. Controller and/or module data.
    e. Thermostats and timers.
    f. Sensors and DP switches.
    g. Valves and valve actuators.
    h. Dampers and damper actuators.
    i. Program setups (software program printouts).

E. Project Record Documents:
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

F. Draft Training Plan:
1. Follow the recommendations of ASHRAE Guideline 1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

G. Training Manuals

1. Provide one copy of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with the contract documents.

1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

3.02 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Provide two-way radios for use during the testing.

D. Valve/Damper Stroke Setup and Check:

1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.

2. Set pump/fan to normal operating mode.

3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.

4. Command valve/damper open; verify position is full open and adjust output signal as required.

5. Command valve/damper to a few intermediate positions.

6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

E. Coil Valve Leak Check:

1. Method 1 - Water Temperature With 2-Way Valve:

a. Calibrate water temperature sensors on each side of coil to be within 0.2 degree F of each other.

b. Turn off air handler fans, close outside air dampers. Keep pump running. Make sure appropriate coil dampers are open.

c. Normally closed valves will close.

d. Override normally open valves to the closed position.

e. After 10 minutes observe water delta T across coil. If it is greater than 2 degrees F, leakage is probably occurring.

f. Reset valve stroke to close tighter.

g. Repeat test until compliance is achieved.

2. Method 2 - Air Temperature With 2 or 3-Way Valve: Water leak-by less than 10 percent will likely not be detected with this method.

a. Calibrate air temperature sensors on each side of coil to be within 0.2 degree F of each other.

b. Air handler fans should be on.

c. Change mixed or discharge air setpoint, override values or bleed or squeeze bulb pneumatic controller to cause the valve to close.

d. After 5 minutes observe air delta T across coil. If it is greater than one degree F, leakage is probably occurring.

e. Reset valve stroke to close tighter.

f. Repeat test until compliance is achieved.

3. Method 3 - Coil Drain Down: Not for 3-way valves.

a. Put systems in normal mode.

b. If cooling coil valve, remove all call for cooling; if heating coil valve, put system in full cooling.

c. Close isolation valve on supply side of coil, open air bleed cap, open drain-down cock and drain water from coil.

d. If water does not stop draining, there may be a leak through the control valve.

e. Return all to normal when done.

F. Isolation Valve or System Valve Leak Check: For valves not by coils.

1. With full pressure in the system, command valve closed.

2. Use an ultra-sonic flow meter to detect flow or leakage.

G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.

F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.

B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with the contract documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.

1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.

2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.

E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.

1. Setpoint changing features and functions.

2. Sensor calibrations.

G. Demonstrate to the Commissioning Authority:

1. That all specified functions and features are set up, debugged and fully operable.

2. That scheduling features are fully functional and setup, including holidays.

3. That all graphic screens and value readouts are completed.

4. Correct date and time setting in central computer.

5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.

6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.

7. Power failure and battery backup and power-up restart functions.

8. Global commands features.

9. Security and access codes.

10. Occupant over-rides (manual, telephone, key, keypad, etc.).
11. O&M schedules and alarms.
12. Occupancy sensors and controls.
13. “After hours” use tracking and billing.
14. Communications to remote sites.
15. Fire alarm interlocks and response.
16. Fire protection and suppression systems interfaces.
17. Security system interlocks.
18. That points that are monitored only, having no control function, are reporting properly to the control system.
19. All control strategies and sequences not tested during controlled equipment testing.
20. Trend logging and graphing features that are specified.
21. Other integrated tests specified in the contract documents
22. That control system features that are included but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system, for minimum period of 5 days including one weekend, if the control points are monitored by the control system:
    1. Duty cycling, if specified.
    2. Demand limiting, including over-ride of limiting.
    3. Sequential staging ON of equipment; optionally demonstrate manually.
    4. Optimum start-stop functions.
    5. Miscellaneous equipment current or status for duty cycling and demand limiting.
    6. Equipment or building kW or current for demand limiting.
    7. Equipment optimum start/stop functions.

I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS

A. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

B. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

C. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING

A. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

B. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.

C. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:

1. HVAC Control System: 1 hours.

D. TAB Review: Instruct Owner's personnel for minimum 1 hours, after completion of TAB, on the following:

1. Review final TAB report, explaining the layout and meanings of each data type.

2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
5. Other salient information that may be useful for facility operations, relative to TAB.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to NFPA 90A standards.

B. Ducts: Galvanized steel, unless otherwise indicated.

C. Low Pressure Supply (System with Cooling Coils): 1/2 inch w.g. pressure class, galvanized steel.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Registers/grilles.

B. Louvers.

PART 2 PRODUCTS

2.01 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, double deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, steel and aluminum with 20 gage, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

2.02 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel frames and blades, with factory baked enamel finish.

2.03 LOUVERS

A. Type: 6 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.

B. Color: To be selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

END OF SECTION

SECTION 23 81 26

SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air cooled condensing units.

B. Indoor air handler (fan & coil) units for duct connection.

C. Controls.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.

D. ASHRAE Std 23.1 - Methods of Testing for Rating the Performance of Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant; 2010.

E. NEMA MG 1 - Motors and Generators; 2017.

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Filters: One for each unit.

1.04 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Mitsubishi; www.mylinkdrive.com.

2.02 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.

1. Heating: None.

2. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.

3. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

2.03 INDOOR UNITS FOR DUCTED SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.

1. Air Flow Configuration: Upflow.

2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.

2. Motor Electrical Characteristics:

C. Air Filters: 1 inch thick glass fiber, disposable type arranged for easy replacement.

D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

2. Manufacturers: System manufacturer.

2.04 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).

1. Provide thermostatic expansion valves.

D. Operating Controls:

1. Control by room thermostat to maintain room temperature setting.

2.05 ACCESSORY EQUIPMENT

A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from setpoint.
3. Short cycle protection.
4. Thermostat Display:
    a. Actual room temperature.
    b. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

A. Install in accordance with NFPA 90A and NFPA 90B.

B. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. 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**:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Metraflex Co.

d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: **EPDM**, **NBR** interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: **Stainless steel**. Include two for each sealing element.

4. Connecting Bolts and Nuts: **Stainless steel** of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.

G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with manufacturer's UL listing requirements.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using **steel** pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements shall be a UL listed assembly.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. **Copper** Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types **THHN-THWN**, **XHHW**.

D. Multiconductor Cable: Comply with NEMA WC 70 for **armored cable, Type AC, mineral-insulated, metal-sheathed cable, Type MI** with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. O-Z/Gedney; EGS Electrical Group LLC.

2. 3M; Electrical Products Division.

3. Tyco Electronics Corp.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

D. Provide Ansi 2-hole pattern Circumferential Crimp compression connectors for each conductor termination AWG size #3 and larger. Including phase, neutral, and ground conductors.

E. All circuit breakers, switches, and disconnects 100 amp and larger to have circumferential crimp connections in lieu of mechanical lugs.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: **Copper.** Stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: **Type XHHW, single conductors in raceway**.

B. Feeders: **THWN, single conductors in raceway**.

C. Branch Circuits: **Type THHN-THWN, single conductors in raceway**.

D. Class 1 Control Circuits: Type THHN-THWN, in raceway.

E. Class 2 Control Circuits: **Type THHN-THWN, in raceway**.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

C. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Provide Ansi 2-hole pattern Circumferential Crimp compression connectors for each conductor termination AWG size #3 and larger. Including phase, neutral, and ground conductors.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least **12 inches (300 mm)** of slack.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test **service entrance and feeder conductors, and conductors feeding the following critical equipment and services** for compliance with requirements.

    a. **Each motor, generator, and panel feeder.**

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each termination in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment**, plus the following special applications:**

1. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.
5. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at **test wells, ground rings**, **grounding connections for separately derived systems** based on **NETA MTS**.

    a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.

    b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: **Copper or tinned-copper** wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted circumferential crimp pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: **Copper-clad**; **3/4 inch by10 feet (19 mm by 3 m)** in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with **nonhazardous electrolytic chemical salts**.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.

2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Underground Grounding Conductors: Install bare **tinned-**copper solid conductor, No. **2** AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

E. Ground-Rod Connections: Install Exothermic weld connectors for underground connections and connections to rods.

F. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

G. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Retain and edit paragraph below to exceed NFPA 70 requirements. If concrete pad is for equipment to be supplied by utility company, revise to comply with utility company's grounding standards or delete and detail on Drawings.

C. Pad-Mounted Transformers, Generators, Fuel Storage Tanks, and Pad-Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG solid for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

H. **Metal** Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

2. For grounding electrode system, install at least [**three**] <**Insert number**> rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through hole in bottom of test well. Test Wells shall be at least 12 inches (300 mm) deep, with traffic rated cover.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal**, at ground test wells, and at individual ground rods**. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

   b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: **10** ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases..

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of **five** times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

1.6 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Fabco Plastics Wholesale Limited.

d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles**, except metal items may be stainless steel**.

4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: **Steel** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, **stainless** steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.

2) Empire Tool and Manufacturing Co., Inc.

3) Hilti Inc.

4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as **required by** NFPA 70. Minimum rod size shall be 3/8 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least **25** percent in future without exceeding specified design load limits.

1. Secure raceways to these supports with **single-bolt conduit clamps**.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. To Steel: **Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps**.

6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate **by means that meet seismic-restraint strength and anchorage requirements**.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "**Cast-in-Place Concrete**."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 **painting Sections** for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. NBR: Acrylonitrile-butadiene rubber.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:

a. Duct entry provisions, including locations and duct sizes.

b. Frame and cover design.

c. Grounding details.

d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Anamet Electrical, Inc.; Anaconda Metal Hose.

3. Electri-Flex Co.

4. Manhattan/CDT/Cole-Flex.

5. Maverick Tube Corporation.

6. O-Z Gedney; a unit of General Signal.

7. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. PVC-Coated Steel Conduit: PVC-coated **rigid steel conduit**.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: **Zinc-coated steel**.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2. Fittings for EMT: **Steel**, **set-screw or compression** type.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CANTEX Inc.

2. CertainTeed Corp.; Pipe & Plastics Group.

3. Condux International, Inc.

4. ElecSYS, Inc.

5. Electri-Flex Co.

6. Lamson & Sessions; Carlon Electrical Products.

7. Manhattan/CDT/Cole-Flex.

8. RACO; a Hubbell Company.

9. Thomas & Betts Corporation.

C. RNC: NEMA TC 2, **Type EPC-40-PVC,** unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Arnco Corporation.

2. Endot Industries Inc.

3. IPEX Inc.

4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for **plenum**, **riser**, or **general-use** installation.

2.4 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.

2. Hoffman.

3. Square D; Schneider Electric.

C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type **3R**, unless otherwise indicated.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: **Hinged type** or **Flanged-and-gasketed type As indicated**.

F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.

2. Lamson & Sessions; Carlon Electrical Products.

C. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

D. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

E. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, **ferrous alloy**, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, **galvanized, cast iron** with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: **Gray**.

2. Configuration: Units shall be designed for flush burial and have **closed** bottom, unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Cover Legend: Molded lettering, **"ELECTRIC." "TELEPHONE." as indicated for each service.**

6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

7. Handholes **12 inches wide by 24 inches long (300 mm wide by 600 mm long)** and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. CDR Systems Corporation.

d. NewBasis.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. Christy Concrete Products.

d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of **cast iron** or **hot-dip galvanized-steel diamond plate**.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carson Industries LLC.

b. Christy Concrete Products.

c. Nordic Fiberglass, Inc.

2.8 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: **EPDM** or **NBR** interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: **Stainless steel**. Include two for each sealing element.
3. Connecting Bolts and Nuts: **Stainless steel** of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.10 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: **Rigid steel conduit**
2. Concealed Conduit, Aboveground: **EMT**.
3. Underground Conduit: RNC, Type EPC-**80**-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **LFMC**.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type **3R**.
6. Application of Handholes and Boxes for Underground Wiring:
    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: SCTE 77, Tier 15 structural load rating.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: **EMT**.
2. Exposed, Not Subject to Severe Physical Damage: **EMT**.
3. Exposed and Subject to Severe Physical Damage: **Rigid steel conduit**. Includes raceways in the following locations:
    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. From below floor level to 6ft above finished floor.
4. Concealed in Ceilings and Interior Walls and Partitions: **EMT**.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: **Rigid steel conduit**.

7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: [**Plenum-type, optical fiber/communications cable raceway**] [**EMT**] <**Insert raceway type**>.

8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, **stainless steel** in damp or wet locations.

C. Minimum Raceway Size: **1/2-inch (16-mm)** trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous rigid aluminum conduit for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Change from RNC, Type EPC-40-PVC, to rigid steel conduit, before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 24 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 **and IEEE C2**.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. **Black letters on a white field**

2. Legend: Indicate voltage **and source**.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.4 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical **and communications** utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE, <**Insert inscription**>.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 10 by 14 inches (250 by 360 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with **black letters on white face**

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black except where used for color-coding.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Essential Power.

2. Non-Essential Power.

3. Fire Alarm

4. Datacom

5. UPS

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase **and Voltage Level** Identification, 600 V or Less: Use colors listed below for conductors.

a. Color shall be factory applied **or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit**.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

D. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: **Baked-enamel warning signs**.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.

b. Controls with external control power connections.

F. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

G. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for **power transfer**, or **load shedding**.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: **Engraved, laminated acrylic or melamine label**. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

   b. Outdoor Equipment: **Engraved, laminated acrylic or melamine label**.

   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be **engraved**, laminated acrylic or melamine label.

   b. Enclosures and electrical cabinets.

   c. Access doors and panels for concealed electrical items.

d. Switchgear.

e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

g. Substations.

h. Emergency system boxes and enclosures.

i. Motor-control centers.

j. Enclosed switches.

k. Enclosed circuit breakers.

l. Enclosed controllers.

m. Variable-speed controllers.

n. Push-button stations.

o. Power transfer equipment.

p. Contactors.

q. Remote-controlled switches, dimmer modules, and control devices.

r. Battery-inverter units.

s. Battery racks.

t. Power-generating units.

u. Monitoring and control equipment.

v. UPS equipment.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. photoelectric switches.
3. Indoor occupancy sensors.
4. Outdoor motion sensors.
5. Lighting contactors.
6. Emergency shunt relays.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls; a Genlyte Company.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.

2. Astronomic time dial.

3. Eight-Day Program: Uniquely programmable for each weekday and holidays.

4. Skip-a-day mode.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Area Lighting Research, Inc.; Tyco Electronics.

2. Grasslin Controls Corporation; a GE Industrial Systems Company.

3. Intermatic, Inc.

4. Lithonia Lighting; Acuity Lighting Group, Inc.

5. Novitas, Inc.

6. Paragon Electric Co.; Invensys Climate Controls.

7. Square D; Schneider Electric.

8. TORK.

9. Touch-Plate, Inc.

10. Watt Stopper (The).

B. Description: Solid state, with dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.

2. Time Delay: 30-second minimum, to prevent false operation.

3. Lightning Arrester: Air-gap type.

4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allen-Bradley/Rockwell Automation.
2. Area Lighting Research, Inc.; Tyco Electronics.
3. Eaton Electrical Inc; Cutler-Hammer Products.
4. Grasslin Controls Corporation; a GE Industrial Systems Company.
5. Intermatic, Inc.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. MicroLite Lighting Control Systems.
8. Novitas, Inc.
9. Paragon Electric Co.; Invensys Climate Controls.
10. Square D; Schneider Electric.
11. TORK.
12. Touch-Plate, Inc.
13. Watt Stopper (The).

2.4 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.

7. TORK.

8. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.5 OUTDOOR MOTION SENSORS (PIR)

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Paragon Electric Co.; Invensys Climate Controls.
5. RAB Lighting, Inc.
6. TORK.
7. Watt Stopper (The).

B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as raintight according to UL 773A.

1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
   b. Relay: Internally mounted in a standard weatherproof electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

3. Bypass Switch: Override the on function in case of sensor failure.

4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc (11 to 215 lx); keep lighting off during daylight hours.

C. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

D. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.

E. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.6 LIGHTING CONTACTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allen-Bradley/Rockwell Automation.

2. ASCO Power Technologies, LP; a division of Emerson Electric Co.

3. Eaton Electrical Inc.; Cutler-Hammer Products.

4. GE Industrial Systems; Total Lighting Control.

5. Grasslin Controls Corporation; a GE Industrial Systems Company.

6. Hubbell Lighting.

7. Lithonia Lighting; Acuity Lighting Group, Inc.

8. MicroLite Lighting Control Systems.

9. Square D; Schneider Electric.

10. TORK.

11. Touch-Plate, Inc.

12. Watt Stopper (The).

B. Description: Electrically operated and **mechanically** held, combination type complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.

2. Control: On-off operation

2.7 EMERGENCY SHUNT RELAY

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Lighting Control and Design, Inc.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual **or automatic** switching contacts; complying with UL 924.

1. Coil Rating: As shown on drawings

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. **18** AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. **14**AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

2. Buck-boost transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.

2. Coil Material: **Copper**.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Enclosure: **Ventilated**, NEMA 250, **Type 3R**

E. Transformer Enclosure Finish: Comply with NEMA 250.

F. Taps for Transformers 25 kVA and Larger: **Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity**

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of **115**deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

I. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

2. Indicate value of K-factor on transformer nameplate.

J. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

2. Include special terminal for grounding the shield.

3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.

b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.

c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

K. Wall Brackets: Manufacturer's standard brackets.

L. Fungus Proofing: Permanent fungicidal treatment for coil and core.

M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

N. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions**, seismic codes applicable to Project,** and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Detail short-circuit current rating of switchboards and overcurrent protective devices.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail utility company's metering provisions with indication of approval by utility company.

7. Include evidence of NRTL listing for series rating of installed devices.

8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

10. Include diagram and details of proposed mimic bus.

11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. 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.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete,

and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

   b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Do not proceed with interruption of electric service without **Owner's** written permission.

2. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Five** years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: **Panel** mounted.

2. Branch Devices: Panel mounted.

3. Sections front and rear aligned.

C. Nominal System Voltage: **480Y/277 V**.

D. Main-Bus Continuous: 600A.

E. Indoor Enclosures: Steel, NEMA 250, **Type 1**.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's finish over a rust-inhibiting primer on treated metal surface.

G. Customer Power Metering Enclosure: A separate power metering enclosure for indicated metering. Current transformer secondary wiring shall be terminated on meter. **Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.**

H. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, [**silver-plated,**]with tin-plated aluminum or copper feeder circuit-breaker line connections.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.

B. Surge Protection Device Description: UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.

2. Fabrication using bolted compression lugs for internal wiring.

3. Integral disconnect switch.

4. Redundant suppression circuits.

5. Redundant replaceable modules.

6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

7. LED indicator lights for power and protection status.

8. Audible alarm, with silencing switch, to indicate when protection has failed.

9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

10. **Four**-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: **120 kA per mode/240 kA per phase.**

D. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

1. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].

2. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with **interrupting capacity** to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.

   b. Lugs: **Compression** style, suitable for number, size, trip ratings, and conductor material for breakers in excess of 100amps frame size.

   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

   d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.

   e. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

   f. Auxiliary Contacts: **One SPDT switch** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

   g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

   a. Phase Currents, Each Phase: Plus or minus 1 percent.

   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.

   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.

   d. Megawatts: Plus or minus 2 percent.

e. Megavars: Plus or minus 2 percent.

f. Power Factor: Plus or minus 2 percent.

g. Frequency: Plus or minus 0.5 percent.

h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.

i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.

j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in separate enclosure.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied from remote branch circuit.

2.6 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

B. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Switchboard will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories

END OF SECTION

SECTION 26 24 16

PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to [**SEI/ASCE 7**] <**Insert requirement**>.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated.

Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards.[**Submit final versions after load balancing.**]

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to [**NECA 407**] [**NEMA PB 1**].

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding [**minus 22 deg F (minus 30 deg C)**] [**23 deg F (minus 5 deg C)**] to plus 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <**Insert number**> days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

3. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and

other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [**Five**] <**Insert number**> years from date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: [**Two**] <**Insert number**> spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: [**Two**] <**Insert number**> spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. <**Insert extra materials**>.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: [**Flush**] [**Surface**] [**Flush- and surface**]-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, [**Type 1**] <**Insert type**>.

b. Outdoor Locations: NEMA 250, [**Type 3R**] <**Insert type**>.

c. [**Kitchen**] [**Wash-Down**] Areas: NEMA 250, [**Type 4X**] <**Insert type**>, [**stainless steel**] <**Insert material**>.

d. Other Wet or Damp Indoor Locations: NEMA 250, [**Type 4**] <**Insert type**>.

e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, [**Type 5**] [**Type 12**].

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

6. Finishes:

a. Panels and Trim: [**Steel**] [**and**] [**galvanized steel**], factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: [**Galvanized steel**] [**Same finish as panels and trim**].

c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in [**transparent card holder**] [**metal frame with transparent protective cover**].

8. <**Insert optional features**>.

C. Incoming Mains Location: [**Top**] [**Bottom**] [**Top and bottom**].

D. Phase, Neutral, and Ground Buses:

1. Material: [**Tin-plated aluminum**] [**Hard-drawn copper, 98 percent conductivity**].

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

5. Split Bus: Vertical buses divided into individual vertical sections.

6. <**Insert optional features**>.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: [**Tin-plated aluminum**] [**Hard-drawn copper, 98 percent conductivity**].

2. Main and Neutral Lugs: [**Compression**] [**Mechanical**] type.

3. Ground Lugs and Bus-Configured Terminators: [**Compression**] [**Mechanical**] type.

4. Feed-Through Lugs: [**Compression**] [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

6. Gutter-Tap Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

8. <**Insert optional features**>.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. <**Insert manufacturer's name**>.

C. Panelboards: NEMA PB 1, power and feeder distribution type.

D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than [**36 inches (914 mm)**] <**Insert dimension**> high, provide two latches, keyed alike.

E. Mains: [**Circuit breaker**] [**Fused switch**] [**Lugs only**].

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: [**Plug-in**] [**Bolt-on**] circuit breakers.

G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

H. Branch Overcurrent Protective Devices: Fused switches.

I. Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2. External Control-Power Source: [**120-V branch circuit**] [**24-V control circuit**] <**Insert requirement**>.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

5. <**Insert manufacturer's name**>.

C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

D. Mains: [**Circuit breaker**] [**or**] [**lugs only**].

E. Branch Overcurrent Protective Devices: [**Plug-in**] [**Bolt-on**] circuit breakers, replaceable without disturbing adjacent units.

F. Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2. External Control-Power Source: [**120-V branch circuit**] [**24-V control circuit**] <**Insert requirement**>.

G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

H. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

5. <**Insert manufacturer's name**>.

C. Load Centers: Comply with UL 67.

D. Mains: [**Circuit breaker**] [**Lugs only**].

E. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

F. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Current Technology; a subsidiary of Danahar Corporation.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Liebert Corporation.
5. Siemens Energy & Automation, Inc.
6. Square D; a brand of Schneider Electric.
7. <**Insert manufacturer's name**>.

C. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.

D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

E. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

G. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

H. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, [**plug-in**] [**wired-in**] [**bolt-on**], solid-state, parallel-connected, [**modular (with field-replaceable modules)**] [**non-modular**] type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.

1. Accessories:
   a. Fuses rated at 200-kA interrupting capacity.
   b. Fabrication using bolted compression lugs for internal wiring.
   c. Integral disconnect switch.

d. Redundant suppression circuits.

e. Redundant replaceable modules.

f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

g. LED indicator lights for power and protection status.

h. Audible alarm, with silencing switch, to indicate when protection has failed.

i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

j. [**Four**] [**Six**]-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: [**160 kA per mode/320 kA per phase**] [**120 kA per mode/240 kA per phase**] [**80 kA per mode/160 kA per phase**].

3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

   a. Line to Neutral: [**70,000**] <**Insert value**> A.

   b. Line to Ground: [**70,000**] <**Insert value**> A.

   c. Neutral to Ground: [**50,000**] <**Insert value**> A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

5. Protection modes and UL 1449 SVR for grounded wye circuits with [**480Y/277**] [**208Y/120**] [**600Y/347**]-V, three-phase, four-wire circuits shall be as follows:

   a. Line to Neutral: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

   b. Line to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

c. Neutral to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:

   a. Line to Neutral: 400 V.

   b. Line to Ground: 400 V.

   c. Neutral to Ground: 400 V.

7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

   a. Line to Neutral: 400 V, 800 V from high leg.

   b. Line to Ground: 400 V.

   c. Neutral to Ground: 400 V.

8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

   a. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].

   b. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

5. <**Insert manufacturer's name**>.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with [**series-connected rating**] [**interrupting capacity**] to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.

   b. Long- and short-time pickup levels.

   c. Long- and short-time time adjustments.

   d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.

   b. Lugs: [**Compression**] [**Mechanical**] style, suitable for number, size, trip ratings, and conductor materials.

   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Communication Capability: [**Circuit-breaker-mounted**] [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."

f. Shunt Trip: [**120**] [**24**] <**Insert voltage**>-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.

g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage [**without intentional**] [**with field-adjustable 0.1- to 0.6-second**] time delay.

h. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.

j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.

l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [**on**] [**off**] [**on or off**] position.

n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

3. Auxiliary Contacts: [**One**] [**Two**] normally open and normally closed contact(s) that operate with switch handle operation.

2.7 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Current Technology; a subsidiary of Danahar Corporation.

2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

4. Liebert Corporation.

5. Siemens Energy & Automation, Inc.

6. Square D; a brand of Schneider Electric.

7. <**Insert manufacturer's name**>.

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

a. LED indicator lights for power and protection status.

b. Audible alarm, with silencing switch, to indicate when protection has failed.

c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

D. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, [**plug-in**] [**wired-in**] [**bolt-on**], solid-state, parallel-connected, [**modular (with field-replaceable modules)**] [**non-modular**] type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

   a. Fuses rated at 200-kA interrupting capacity.

   b. Fabrication using bolted compression lugs for internal wiring.

   c. Integral disconnect switch.

   d. Redundant suppression circuits.

   e. Redundant replaceable modules.

   f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

   g. LED indicator lights for power and protection status.

   h. Audible alarm, with silencing switch, to indicate when protection has failed.

   i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

   j. [**Four**] [**Six**]-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: [**160 kA per mode/320 kA per phase**] [**120 kA per mode/240 kA per phase**] [**80 kA per mode/160 kA per phase**].

3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

   a. Line to Neutral: [**70,000**] <**Insert value**> A.

   b. Line to Ground: [**70,000**] <**Insert value**> A.

   c. Neutral to Ground: [**50,000**] <**Insert value**> A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

5. Protection modes and UL 1449 SVR for grounded wye circuits with [**480Y/277**] [**208Y/120**] [**600Y/347**]-V, three-phase, four-wire circuits shall be as follows:

   a. Line to Neutral: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

   b. Line to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

   c. Neutral to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:

   a. Line to Neutral: 400 V.

   b. Line to Ground: 400 V.

   c. Neutral to Ground: 400 V.

7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

   a. Line to Neutral: 400 V, 800 V from high leg.

   b. Line to Ground: 400 V.

   c. Neutral to Ground: 400 V.

8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

   a. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].

   b. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to [**NECA 407**] [**NEMA PB 1.1**].

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to [**NECA 407**] [**NEMA PB 1.1**].

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "[**Cast-in-Place Concrete**] [**Miscellaneous Cast-in-Place Concrete**]."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to panelboards.

5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim [**90 inches (2286 mm)**] <**Insert height**> above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties[**after completing load balancing**].

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads[**after balancing panelboard loads**]; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges [**as indicated**] [**as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."**]

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 24 19

MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes motor-control centers for use on ac circuits rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.

2. Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for low-voltage power, control, and communication surge suppressors.

1.3 SUBMITTALS

A. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each motor-control center.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current ratings of buses and installed units.

d. Vertical and horizontal bus capacities.

e. UL listing for series rating of overcurrent protective devices in combination controllers.

f. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that motor-control centers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For motor-control centers, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for motor-control centers and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Handle motor-control centers according to the following:

1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."

2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

1.6 COORDINATION

A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

D. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Cutler-Hammer Products.
2. Siemens/Furnas Controls.
3. Square D.

2.2 MOTOR-CONTROL CENTERS

A. Wiring: NEMA ICS 3, Class **I, Type A**. Revise paragraph and subparagraphs below if other-than-routine indoor installation conditions apply. Coordinate with Drawings. See Evaluations for other enclosure types.

B. Enclosures: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
3. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
4. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

2.3 BUSES

A. Material: **Plated hard-drawn copper, 98 percent conductivity**.

B. Ampacity Ratings: As indicated for horizontal and vertical main buses.

C. Neutral Buses: **Full** size.

D. Equipment Ground Bus: Noninsulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.

E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.

B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.

1. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.

3. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or drawout terminal boards for external control connections.

4. Controller Disconnecting Means: Factory-assembled combination disconnect and controller.

a. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.

b. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.

c. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

D. Transient Voltage Surge Suppressors: Connect to motor-control center bus.

E. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

F. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare."

2.5 ACROSS-THE-LINE CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from **integral control power transformer** with a control power sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class **10** tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

3. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class **10** tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

2.6 REDUCED-VOLTAGE CONTROLLERS

A. Star-Delta Controller: NEMA ICS 2, closed transition with adjustable time delay.

B. Part-Winding Controller: NEMA ICS 2, closed transition with separate overload relays for starting and running sequences.

C. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

D. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.

2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

3. LED indicators showing motor and control status, including the following conditions:

   a. Control power available.

   b. Controller on.

   c. Overload trip.

   d. Loss of phase.

   e. Shorted silicon-controlled rectifier.

4. Automatic voltage-reduction controls to reduce voltage when motor is running at light load.

5. Motor running contactor operating automatically when full voltage is applied to motor.

2.7 MULTISPEED CONTROLLERS

A. Multispeed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:

1. Compelling relay to ensure that motor will start only at low speed.
2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
3. Decelerating relay to ensure automatically timed deceleration through each speed.

2.8 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, pulse-width-modulated, variable frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.

1. Provide unit suitable for operation of **premium**-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Isolation Transformer: Match transformer voltage ratings and capacity to system and motor voltages; and controller, motor, and load characteristics.

D. Output Rating: 3-phase; 6 to **120 Hz, with horsepower constant throughout speed range**.

E. Unit Operating Requirements:

1. Input ac voltage tolerance of **380 to 500 V, plus or minus 10** percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

6. Starting Torque: 100 percent of rated torque or as indicated.

7. Speed Regulation: Plus or minus 1 percent.

8. Ambient Temperature: 0 to 40 deg C.

F. Isolated control interface allows controller to follow control signal over an 11:1 speed range.

1. Electrical Signal: 4 to 20 mA at 24 V.

2. Pneumatic Signal: 3 to 15 psig (20 to 104 kPa).

G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: 2 to a minimum of 22 seconds.

4. Deceleration: 2 to minimum of 22 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

H. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.

2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class **10** performance.

4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

5. Instantaneous line-to-line and line-to-ground overcurrent trips.

6. Loss-of-phase protection.

7. Reverse-phase protection.

8. Short-circuit protection.

9. Motor overtemperature fault.

I. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

J. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration shall not damage controller, motor, or load.

K. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.

L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

N. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate controller output current, voltage, and frequency.

O. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected.

P. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

Q. Integral Disconnecting Means: **NEMA AB 1, instantaneous-trip circuit breaker** with lockable handle.

R. Isolating Switch: Non-load-break switch arranged to isolate variable frequency controller and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

S. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.9 FEEDER OVERCURRENT PROTECTION

A. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

5. GFCI Circuit Breakers: Single- and two-pole configurations with [**5**] [**30**]-mA trip sensitivity.

6. Molded-Case Switch: Molded-case circuit breaker without trip units.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: **Compression** style, suitable for number, size, trip ratings, and material of conductors.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

3. Ground-Fault Protection: **Integrally mounted** relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

4. Communication Capability: **Din-rail-mounted** communication module with functions and features compatible with power monitoring and control system.

5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.

6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage **with field-adjustable 0.1- to 0.6-second** time delay.

7. Auxiliary Switch: **Two SPDT switches** with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts; "b" contacts operate in reverse of circuit-breaker contacts.

8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

C. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses with lockable handle.

2.10 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Elapsed Time Meters: Heavy duty with digital readout in hours.

F. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide transfer device with an off position. Meters shall indicate the following:

1. Ammeter: Output current, with current sensors rated to suit application.
2. Voltmeter: Output voltage.
3. Frequency Meter: Output frequency.

G. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
2. Switch-selectable digital display of the following:
    a. Phase Currents, Each Phase: Plus or minus 1 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    d. Three-Phase Real Power: Plus or minus 2 percent.
    e. Three-Phase Reactive Power: Plus or minus 2 percent.
    f. Power Factor: Plus or minus 2 percent.
    g. Frequency: Plus or minus 0.5 percent.
    h. Integrated Demand with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
    i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

H. Phase-Failure and Undervoltage Relays for Bypass Controllers: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

I. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.11 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested, motor-control centers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, **,** and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each motor-control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor-control center mounting surface.

B. Install motor-control centers on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

A. Identify motor-control center, motor-control center components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

B. Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of motor-control centers.

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation.

2. To assist in field testing of equipment **including pretesting and adjusting of solid-state controllers**.

3. Report results in writing.

C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

E. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain components of motor-control centers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Wall-box motion sensors.
4. Snap switches and wall-box dimmers.
5. Solid-state fan speed controls.
6. Wall-switch and exterior occupancy sensors.
7. Communications outlets.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; HBL5351 (single), CR5352 (duplex).

    b. Leviton; 5891 (single), 5352 (duplex).

    c. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, **non-feed**-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; GF20.

    b. Pass & Seymour; 2084.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cooper Crouse-Hinds.

   b. EGS/Appleton Electric.

   c. Killark; a division of Hubbell Inc.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; L520R.

   b. Hubbell; HBL2310.

   c. Leviton; 2310.

   d. Pass & Seymour; L520-R.

B. Comply with NEMA WD 1 and UL 20.

C. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).

   b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).

   c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

   d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

D. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 2221PL for 120 V and 277 V.

   b. Hubbell; HPL1221PL for 120 V and 277 V.

   c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.

   d. Pass & Seymour; PS20AC1-PLR for 120 V.

   e.

3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.6 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 6111 for 120 V, 6117 for 277 V.

   b. Hubbell; WS1277.

   c. Leviton; ODS 10-ID.

   d. Pass & Seymour; WS3000.

   e. Watt Stopper (The); WS-200.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Exterior Occupancy Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Leviton; PS200-10.

b. Watt Stopper (The); EW-100-120.

3. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot (34-m) detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.7 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 3560-6.

b. Leviton; 40649.

3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

2.8 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: **0.035-inch- (1-mm-) thick, satin-finished stainless steel**

3. Material for Unfinished Spaces: **Galvanized steel**

4. Material for Damp Locations: **Cast aluminum** with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant **, die-cast aluminum** with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles **up**, and on horizontally mounted receptacles to the **right**.

2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan speed control are listed for that application.

3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with **black**-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Ground Impedance: Values of up to 2 ohms are acceptable.

3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

4. Using the test plug, verify that the device and its outlet box are securely mounted.

5. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION

SECTION 26 29 23

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.

B. Related Sections include the following:

1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
2. Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for low-voltage power, control, and communication surge suppressors.

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.4 SUBMITTALS

A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings: For each VFC.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

    a. Each installed unit's type and details.
    b. Nameplate legends.
    c. Short-circuit current rating of integrated unit.
    d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
    e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that VFCs, accessories, and components will withstand local seismic forces. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for VFCs and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFCs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (noncondensing).
3. Altitude: Not exceeding 3300 feet (1005 m).

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with JEA Water/Wastewater 2021 Standards and requirements, provide products by one of the following:
1. ASEA Brown Boveri (ABB) LTD. Model ACQ580.
2. Danfoss Company Model VLT Aquadrive
3. Schneider Electric Products Model Altivar Process ATV630
4. Siemens Energy and Automation; Industrial Products Division Model G120X.
5. Toshiba Industrial Products and Systems Corp Model VF-AS3

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Provide unit suitable for operation of **premium**-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to **120 Hz, with horsepower constant throughout speed range**.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of **380 to 500 V, plus or minus 10** percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.

E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

1. Electrical Signal: 4 to 20 mA at 24 V.
2. Pneumatic Signal: 3 to 15 psig (20 to 104 kPa).

F. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class **10**.
4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
5. Instantaneous line-to-line and line-to-ground overcurrent trips.
6. Loss-of-phase protection.

7. Reverse-phase protection.
8. Short-circuit protection.
9. Motor overtemperature fault.

H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

J. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

N. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

O. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. RS485.
    f. Keypad display for local hand operation.

4. Output Signal Interface:

    a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hz).
        2) Output current (load).
        3) DC-link voltage (VDC).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hz).

5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

    a. Motor running.
    b. Set-point speed reached.
    c. Fault and warning indication (overtemperature or overcurrent).
    d. PID high- or low-speed limits reached.

P. Provide remote-mountable control panel (HMI) with full control, adjustment, and monitoring functionality.

Q. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.

R. Integral Disconnecting Means: **NEMA AB 1, instantaneous-trip circuit breaker** with lockable handle.

S. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

F. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFCs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

B. Install VFCs on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Common Work Results for Electrical," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

   1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

   1. Inspect controllers, wiring, components, connections, and equipment installation.
   2. Assist in field testing of equipment.
   3. Report results in writing.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

   1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 32 13

ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for **standby** power supply with the following features:

1. **Diesel** engine.
2. **Unit-mounted** cooling system.
3. **Unit-mounted** control and monitoring.
4. Performance requirements for sensitive loads.
5. Sub-base fuel tank.
6. Outdoor storm rated, sound attenuating enclosure.
7. Critical grade silencer.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

4. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that sub-base fuel tank**,** engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic

forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For **installer manufacturer and testing agency**.

E. Source quality-control test reports.

1. Certified summary of prototype-unit test report.

2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.

7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than **four** hours normal travel time from Installer's place of business to Project site.

2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within **200 miles (321 km)** Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 99.

J. Comply with NFPA 110 requirements for Level **1** emergency power supply system.

K. Comply with UL 2200.

L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

M. Noise Emission: Comply with **applicable state and local government requirements** for maximum noise level at **adjacent property boundaries** due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner and Engineer 30 days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Engineers written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: **5 to 40 deg C**.

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to **1000 feet (300 m)**.

C. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:

1. **High salt-dust content in the air due to sea-spray evaporation**.

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide **12** months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:

1. Caterpillar; Engine Div.
2. Generac Power Systems, Inc.
3. Onan/Cummins Power Generation; Industrial Business Group.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated**, with capacity as required to operate as a unit as evidenced by records of prototype testing**.

2. Output Connections: Three-phase, **four** wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load

current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

   a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: **Fuel oil, Grade DF-2**

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

   a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.

   b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine-driven coolant pump.

1. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

2. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

3. Fan: Driven by **multiple belts from engine shaft**

4. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.

2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be **85**dBA or less.

J. Air-Intake Filter: **Heavy**-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: **24**V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: **60 seconds**.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least **three times** without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to

a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator.

2. Capacity: Fuel for 72 hours' continuous operation at 100 percent rated power output.

3. Vandal-resistant fill cap.

4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in

one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:

1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.

2. Transformers: Instrument accuracy class.

D. Indicating and Protective Devices and Controls:

1. AC voltmeter.

2. AC ammeter.

3. AC frequency meter.

4. DC voltmeter (alternator battery charging).

5. Engine-coolant temperature gage.

6. Engine lubricating-oil pressure gage.

7. Running-time meter.

8. Ammeter-voltmeter, phase-selector switch(es).

9. Generator-voltage adjusting rheostat.

10. Start-stop switch.

11. Overspeed shutdown device.

12. Coolant high-temperature shutdown device.

13. Coolant low-level shutdown device.

14. Oil low-pressure shutdown device.

15. Fuel tank derangement alarm.

16. Fuel tank high-level shutdown of fuel supply alarm.

17. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in JEA standards.

G. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.

2. Lube-oil, low-pressure shutdown.

3. Overspeed shutdown.

4. Remote emergency-stop shutdown.

5. Engine high-temperature prealarm.

6. Lube-oil, low-pressure prealarm.

7. Fuel tank, low-fuel level.

8. Low coolant level.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Disconnect Switch: Molded-case type, 100 percent rated.

1. Rating: Matched to generator output rating.

2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.

2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.

3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Drip-proof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: **12** percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Prefabricated or preengineered walk-in enclosure with the following features:

1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.

2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.

3. Space Heater: Thermostatically controlled and sized to prevent condensation.

4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.

5. Hinged Doors: With padlocking provisions.

6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.

7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.

8. Muffler Location: **External to** enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

C. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.

2. DC lighting system for operation when remote source and generator are both unavailable.

D. Convenience Outlets: Factory wired[**, GFCI**]. Arrange for external electrical connection.

2.9 MOTORS

A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set and [**remote radiator**] [**heat exchanger**] with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Division 23 Section "Facility Fuel-Oil Piping."

2. Natural-gas piping, valves, and specialties for gas distribution are specified in Division 23 Section "Facility Natural-Gas Piping."

3. LP-gas piping, valves, and specialties for gas piping are specified in Division 23 Section "Facility Liquefied-Petroleum Gas Piping."

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection[**(except those indicated to be optional)**] for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.

c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

7. Exhaust Emissions Test: Comply with applicable government test criteria.

8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at [**four**] <**Insert number**> locations [**on the property line**] <**Insert location for measurement**>, and compare measured levels with required values.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

J. Remove and replace malfunctioning units and [**retest**] [**reinspect**] as specified above.

K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 36 00

TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Bypass/isolation switches.
3. Nonautomatic transfer switches.
4. Remote annunciation systems.
5. Remote annunciation and control systems.

B. Related Sections include the following:

1. Division 26 Section "263213 ENGINE GENERATORS".

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in

Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For **manufacturer and testing agency**.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing

laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain **automatic transfer switches**, **bypass/isolation switches**, **nonautomatic transfer switches**, **remote annunciators** through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify **Owner** no fewer than seven days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without **Owner's** written permission.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Caterpillar; Engine Div.

b. Emerson; ASCO Power Technologies, LP.

c. Zenith; ZTS-D/L

d. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Battery Charger: For generator starting batteries.

1. Float type rated **10** A.

2. Ammeter to display charging current.

3. Fused ac inputs and dc outputs.

H. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

J. Enclosures: General-purpose NEMA 250, Type **1**, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:

1. Fully automatic make-before-break operation.

2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.

3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

   a. Initiation occurs without active control of generator.

   b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

H. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be

completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

I. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

J. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

K. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.

12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

    b. Push-button programming control with digital display of settings.

c. Integral battery operation of time switch when normal control power is not available.

2.4 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Indication of switch position.
3. Indication of switch in test mode.
4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of switch-test initiation.
7. Control of switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Controls and indicating lights grouped together for each transfer switch.
2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
3. Digital Communication Capability: Matched to that of transfer switches supervised.
4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.5 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Division 26 Section "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.

    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

    c. Verify that manual transfer warnings are properly placed.

    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

    b. Simulate loss of phase-to-ground voltage for each phase of normal source.

    c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.

e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

D. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.

e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

E. Coordinate tests with tests of generator and run them concurrently.

F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 41 13

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes lightning protection for **building site components**.

1.3 DEFINITIONS

A. LPI: Lightning Protection Institute.

B. NRTL: National recognized testing laboratory.

1.4 SUBMITTALS

A. Product Data: For air terminals and mounting accessories.

B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

C. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.

D. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.

E. Field inspection reports indicating compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer.

B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning Protection, Inc.
2. Heary Bros. Lightning Protection Co. Inc.
3. Independent Protection Co.
4. Robbins Lightning Inc.
5. Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96.

B. Roof-Mounting Air Terminals: NFPA Class **I solid**, unless otherwise indicated.

1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.

C. Stack-Mounting Air Terminals: **Stainless steel**.

D. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with standards referenced in this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to **UL 96A and NFPA 780**.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view from exterior locations at grade within 200 feet (60 m) of building.
5. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

D. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

G. A counterpoise installation based on requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.

1. Bond ground terminals to counterpoise conductor.

2. Bond grounded metal bodies on building within 12 feet (3.6 m) of ground to counterpoise conductor.

3.2 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

A. UL Inspection: Provide inspections as required to obtain a UL Master Label for system.

B. Provide an inspection by an inspector certified by LPI to obtain an LPI certification.

END OF SECTION

SECTION 26 43 13

TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Qualification Data: For qualified testing agency.

C. Product Certificates: For TVSS devices, from manufacturer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

F. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with **UL 1283 and** UL 1449.

F. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protection Devices:

1. Comply with UL 1449.

2. Fuses, rated at 200-kA interrupting capacity.

3. Fabrication using bolted compression lugs for internal wiring.

4. Integral disconnect switch.

5. Redundant suppression circuits.

6. Redundant replaceable modules.

7. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.

8. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

9. LED indicator lights for power and protection status.

10. Audible alarm, with silencing switch, to indicate when protection has failed.

11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

12. Six digit transient-event counter set to totalize transient surges.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 **Type 1**.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multiple, [**30**] [**60**] [**100**]-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.

3. Complete startup checks according to manufacturer's written instructions.

E. TVSS device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect [**service entrance equipment**] [**panelboards**] [**control terminals**] [**data terminals**] to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.

3. Ballast.

4. Energy-efficiency data.

5. Life, output, and energy-efficiency data for lamps.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Comply with NFPA 70.

C. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: **10** years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period: **One** year(s) from date of Substantial Completion.PRODUCTS

1.8 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

1.9 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

1.10 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

1.11 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

7. Integral Time-Delay Relay: Holds unit on for fixed interval of **15** minutes when power is restored after an outage.

8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

1.12 LIGHTING FIXTURES

A. Fixture Type See Fixture Schedule.

EXECUTION

1.13 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. LED lamps to be provided in each fixture.

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

1.14 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. HID: High-intensity discharge.

C. Luminaire: Complete lighting fixture, including ballast housing if provided.

D. Pole: Luminaire support structure, including tower used for large area illumination.

E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

B. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

C. Qualification Data: For agencies providing photometric data for lighting fixtures.

D. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: **Five** years from date of Substantial Completion.

2. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than **three** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

C. Exposed Hardware Material: Stainless steel.

D. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

E. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

G. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

H. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

2.4 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.

3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.5 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); 1-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

2.6 PRESTRESSED CONCRETE POLES

A. Poles: Manufactured **of cast concrete**.

1. Shape: Square**, tapered**.

2. Finishing: Capped at top and plugged at bottom. Seat each steel reinforcing strand with epoxy adhesive.

3. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole **and attach to 24-inch (610-mm) lightning rod**.

B. Cure with wet steam and age for a minimum of 15 days before installation.

C. Fabricate poles with a hard, nonporous surface that is resistant to water, frost, and road and soil chemicals and that has a maximum water-absorption rate of 3 percent.

D. Cast aluminum nameplate into pole wall at approximately 5 feet (1.5 m) above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.

E. Pole Brackets: Comply with ANSI C136.13.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

B. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: **60 inches** .

2. Water, Gas, Electric, Communication, and Sewer Lines: **10 feet (3 m).**

3. Trees: **15 feet (5 m)**.

C. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Dig holes large enough to permit use of tampers in the full depth of hole.

2. Backfill in 6-inch (150-mm) layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

D. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with **pea gravel** to a level 1 inch (25 mm) below top of concrete slab.

E. Raise and set poles using web fabric slings (not chain or cable).

3.3 CORROSION PREVENTION

A. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.

2. Install grounding conductor and conductor protector.

3. Ground metallic components of pole accessories and foundations.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 31 11 00

SITE PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Layout of work and protection of bench marks.

B. Protection of structures, trees, or vegetation to remain.

C. Clearing and grubbing.

D. Stripping and storing topsoil.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching, Bedding and Backfilling

B. Section 31 25 00 - Erosion and Sedimentation Control

1.03 COORDINATION

A. Refer to Drawing G-02 for a list of utility companies that may have facilities in the project area and coordinate with them to avoid service interruptions and/or safety hazards:

B. Contact "Sunshine State, One-Call" 1-800-432-4770, to determine if there are other utilities in the area, and their location.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 BENCH MARKS AND MONUMENTS

Maintain all existing benchmarks, monuments and other reference points; if destroyed, replacement costs will be deducted from payments due the Contractor.

3.02 LAYING OUT WORK

A. Base lines, property lines, and easement lines, are shown on the Drawings. Benchmarks utilized are also shown on the drawings. If the bench marks are disturbed as a result of construction activities, reestablish such items by utilizing a Florida licensed surveyor.

B. Stake out the construction, establish lines and levels, temporary bench marks, batter boards, centerlines and reference points for the work, and verify all dimensions relating to interconnection with existing features.

C. Report any inconsistencies in the proposed grades, lines and levels, dimensions and locations to the Engineer before commencing work.

3.03 BURNING

Burning is not allowed.

3.04 PROTECTION OF TREES AND SHRUBS

Existing trees and shrubs within the right-of-way and easements along the work zones shall remain unless specifically required to be removed as indicated on the Drawings. Protect branches, trunks, and roots of trees and shrubs that are to remain. Trees to remain in the construction area shall be boxed, fenced or otherwise protected before any work is started; remove boxing when directed by the Engineer. Do not permit heavy equipment or stockpiles within branch spread. Remove interfering branches without injury to trunks and cover scars with tree paint.

3.05 RELOCATION OF UTILITIES

A. Active utilities which do not interfere with the work shall be supported and protected from damage. After obtaining the Engineer's approval, relocate or remove active utilities which will interfere with work as indicated. Pay for all damage to active utilities and for relocation or removal of all interfering utilities which are ascertainable from Drawings, surveys, site inspection or encountered during construction.

B. Inactive or abandoned utilities and appurtenant structures encountered shall be removed to avoid interference as directed by the Engineer. Exposed ends of abandoned lines shall be plugged or capped in a water-tight manner.

3.06 CLEARING AND GRUBBING

A. Areas to receive clearing and grubbing shall include all areas to be occupied by the proposed improvements, areas for fill and site grading, and borrow sites. Remove trees outside of these areas only as indicated on the Drawings or as approved in writing by the Engineer

B. Clearing shall consist of removing trees and brush and disposal of other materials that encroach upon or otherwise obstruct the work.

C. Exercise extreme care during the clearing and grubbing operations to not damage existing structures, pipes or utilities.

D. Grubbing shall consist of removing and disposing of stumps, roots larger than 2" in diameter, and matted roots. Remove to a depth of not less than 18" below the original surface level of the ground.

E. All combustible debris and refuse from site preparation operations shall be removed to legal off-site disposal areas.

3.07 TOPSOIL REMOVAL

A. All areas to be occupied by proposed improvements, and borrow sites shall be stripped of all brush, weeds, grass, roots and other material.

B. Remove all loamy, organic topsoil suitable for seeding and planting to whatever depth encountered and store separately from other excavated material. Stockpile in designated areas and provide for proper drainage. Cover storage piles as required to prevent windblown dust.

C. In the event that inadequate space within the site or work area is available for stock-piling topsoil without interfering with other construction operations, contact Owner for determination of another storage location.

D. Dispose of unsuitable topsoil as specified under disposal of debris. Excess topsoil shall be removed from site unless specifically noted on Contract Drawings.

3.08 DISPOSAL OF DEBRIS

A. All combustible debris and refuse from site preparation operations shall be burned if allowable and properly permitted, or removed to legal off-site disposal areas.

B. All non-combustible debris (not including acceptable fill material, fences, or other structures), resulting from site preparation operations shall become the property of the CONTRACTOR and shall be removed to legal off-site disposal areas.

END OF SECTION

SECTION 31 22 00

FINISH GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

Topsoil placement, grading of site

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil shall be fertile, friable, natural topsoil typical of the area, free from subsoil, stones, plants, roots or other extraneous material and shall not be used while muddy or frozen.

B. Topsoil shall contain not less than 8% organic matter (AASHTO T194). The topsoil shall consist of either natural topsoils typical of the locality and free from coarse stone aggregate or surface soils stripped from the site and enriched with humus at a rate of 8% by volume. The soil mixture prepared by mixing surface soils and humus shall be free of oil, cinders, coarse stone, and woody root material.

PART 3 EXECUTION

3.01 GENERAL

Provide all topsoil placement and finish grading and filling to achieve the lines and grades indicated on the Drawings. All earthwork shall be done in a manner that provides drainage.

3.02 TOPSOIL PLACEMENT

Place topsoil in all areas of new grading. The compacted subgrade to receive topsoil shall be scarified to a depth of 3 inches. Topsoil shall be spread evenly and compacted to a thickness of not less than 4 inches, 8 inches in areas to be grassed and planted, and to the proposed elevations and grades. Grade flush with walks, curbs, and paving.

3.03 FINISH GRADING

A. All areas of the project including all previously grassed areas that have been disturbed, borrow sites, excavated and filled sections and adjacent transition areas shall be uniformly smooth-graded. Depressions from settlement shall be filled and compacted. Tops of embankments and breaks in grade shall be rounded. All surfaces shall be finished to provide adequate drainage. Finished surfaces shall be reasonably smooth, compacted, free from irregular surface changes and comparable to the smoothness obtained by blade-grader operations.

B. Slope grades to drain away from structures at a minimum of 3-inch per foot for 10 feet.

C. Finished surfaces adjacent to paved or surfaced areas and within 10 feet of structures shall be within 1 inch of the proposed grade. All other areas shall be within 3 inches of the proposed grade.

D. Newly graded areas shall be protected from traffic and erosion. All settlement or washing away that may occur from any cause prior to seeding or acceptance shall be repaired and grades re-established to the required elevations and slopes at no additional cost to the Owner.

E. Unless otherwise indicated, all surplus material shall be disposed of by the Contractor.

END OF SECTION

SECTION 31 23 00

EXCAVATION AND FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavation and fill for roads, ponds, general site work

B. Sheeting, shoring and bracing

C. Compaction

1.02 RELATED SECTIONS

A. Section 31 11 00 - Site Preparation

B. Section 31 22 00 - Finish Grading

C. Section 31 23 19 - Dewatering

D. Section 31 23 33 - Trenching, Bedding, and Backfilling

E. Section 31 25 00 - Erosion and Sedimentation Control

F. Meskel & Associates Engineering, PLLC's Soils Report (Attached)

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:

AASHTO M145 - Classification of Soils

AASHTO T180 - Moisture-Density Soil Sampling and Testing

B. American Society for Testing and Materials (ASTM) latest edition:

1. ASTM D1557 - Moisture-Density Soil Sampling and Testing
2. ASTM D2487 - Classification of Soils

C. Occupational Safety and Health Administration (OSHA) Regulations, including:

1. Part 1926 Subpart P - Excavations

1.04 DEFINITIONS

A. Backfill - material placed in newly excavated areas the topsoil, paving sub-grade, or foundation level.

B. Influence Area - the area within lines sloped downward at 45 degrees from the outer edges of paving, foundations, and utility lines.

1.05 QUALITY ASSURANCE

A. Field density testing frequencies:

1. One test for each 10,000 square feet or fraction thereof per lift of general backfilling, minimum 2 tests each layer.

2. One test for each 100 square feet or fraction thereof of backfill around and under structures.

3. One test per lift per each change in type of fill.

4. One test per 1000 square feet of pavement subgrade, minimum of 2 tests.

1.06 PRECONSTRUCTION REQUIREMENTS

Precondition surveys and vibration monitoring are required for those areas where residential structures are within 100 feet of the proposed construction.

PART 2 PRODUCTS

2.01 GENERAL

It is intended that previously excavated materials conforming to the following requirements be utilized wherever possible.

2.02 MATERIALS

A. Acceptable materials: AASHTO M145 classification A-1, A-3, A-2-4, A-2-6; ASTM D2487 classification GW, GP, GM, SM, SW, SP; unless otherwise disapproved within the Soil and Subsurface investigation reports. No more than 12% of acceptable materials shall pass the number 200 sieve.

B. Unacceptable materials: AASHTO M145 classification A-2-5, A-2-7, A-4, A-5, A-6, A-7, A-8; ASTM D2487 classification GC, SC, ML, MH, CL, CH, OL, OH, PT; unless otherwise approved within the Soil and Subsurface investigation reports.

C. Controlled low strength material ("excavatable flowable fill") shall meet the requirements of FDOT specification section 121, with a 28-day compressive strength of 80-100 psi.

2.03 SHEETING, SHORING, AND BRACING

A. The structural strength and safety of all sheeting, shoring and bracing shall be the sole responsibility of the Contractor. Repair any damage resulting from failure to provide adequate supports.

B. Provide timber work, shoring, bracing, sheeting, and sheet piling where necessary to retain banks of excavations, prevent cave-in of adjacent ground, prevent displacement of utilities and structures, and to protect public safety.

C. Contractor is solely responsible for the design, installation, and operation of dewatering systems and their safety and conformity with local codes and regulations.

PART 3 EXECUTION

3.01 GENERAL CONSTRUCTION REQUIREMENTS

A. Provide suitable temporary drainage channels for any water that may flow along or across the work as specified hereafter.

B. Provide barriers, warning lights and other protective devices at all excavations.

C. Sidewalks, roads, streets, and pavements shall not be blocked or obstructed by excavated materials, except as authorized by the Engineer, in which case adequate temporary provisions must be made for satisfactory temporary passage of pedestrians, and vehicles. Minimize inconvenience to public travel or to tenants occupying adjoining property.

D. Where necessary to place excavated material adjacent to buildings, erect barriers to keep earth at least 4' from such buildings. Earth deposited on lawns shall be promptly and carefully removed to preserve the turf. All trees, shrubs,

and landscaping shall be protected. Boring and jacking shall be used, if necessary, except where written permission is granted to remove trees and shrubs.

E. If open excavations cross existing rigid surfacing, the surfacing shall be removed for a width one foot beyond the anticipated edge of the excavation. The pavement break shall be sawed to insure a straight joint. Surface replacement shall match existing surfacing except as otherwise indicated on the Drawings. Where open excavation is allowed along or across public roadways, excavation, backfill, and surface replacement shall conform to the requirements of all permits applicable thereto. In no case shall surface replacement edges bear on less than 12" of undisturbed soil.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Locate and identify existing utilities that are to remain and protect from damage.

C. Notify utility companies to remove or relocate utilities that are in conflict with proposed improvements.

D. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

F. Prior to placing fill in low areas, such as previously existing ditches, ponds, or lakes, perform following procedures:

1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.

2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.

3. If proposed for fill, muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation by Engineer. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under building or pavement subgrade or within 10'-0" of perimeter of building subgrade or paving subgrade. If, after observation by Engineer, material is found to be unsuitable, unsuitable material shall be removed from site.

3.03 SHEETING, SHORING, AND BRACING

A. Furnish, install, and maintain, without additional compensation, sheeting, bracing, and shoring support required to keep excavations within the easement provided, to support the sides of the excavation, and to prevent any movement which may damage adjacent pavements or structures, damage or delay the work, or endanger life and health. Voids outside the supports shall be immediately filled and compacted.

B. Sheeting, where required, shall be driven below the bottom of excavation so the lowest set of wales and struts are above the bottom of the excavation to allow necessary working room.

C. The Engineer may direct in writing that supports in trenches be cut off at any specified elevation, in which case Contractor shall be paid for the supports left in place.

D. Contractor may leave in place, to be embedded in the backfill of the excavation, any or all supports for the purpose of preventing injury to persons or property, whether public or private. However, no supports that are within 4’ of the ground or pavement surface may be left in place without written permission of the Engineer. No extra payment will be made for supports left in place at the Contractor's option.

E. All supports not left in place shall be removed in such manner as to avoid endangering the piping, structures, utilities or property, whether public or private. All voids left by the withdrawal of sheeting shall be immediately filled and compacted.

F. The right of the Engineer to order supports left in place shall not be construed as creating an obligation on his part to issue such orders. Failure by the Engineer to exercise this right shall not relieve the Contractor from total liability for damages to persons or property resulting from the failure of the Contractor to leave in place sufficient supports to prevent any caving or moving of the ground adjacent to the excavation.

3.04 EXCAVATION

A. Do not excavate for any structure until that structure is scheduled for construction. Excavate only to the depth and dimensions necessary for the construction. Slope sides of excavations in accordance with OSHA requirements and the recommendations contained within the project geotechnical report.

B. The bottom of all excavations shall be undisturbed earth unless otherwise indicated, and shall be approved by the Engineer before any subsequent work is started. Over excavate a minimum of 2 feet where excavations occur within unsuitable soils, and replace over excavated material with suitable soils.

C. Excavations carried below depths indicated on the Drawings without the previous approval of the Engineer shall be filled with 2500 psi concrete or flowable fill to the correct level at the expense of the Contractor.

D. Maintain excavations in good order. If the bearing capacity of the foundation soils is reduced because the excavation is allowed to remain open prior to commencing work, the weathered soil shall be removed and replaced with 2500 psi concrete or flowable fill at the Owner's discretion at the expense of the Contractor.

E. All suitable materials removed from excavation areas shall be used for the project. Excess excavated suitable material shall be stockpiled on site at a location of the Owner's choosing, and shall become the property of the Owner, unless otherwise indicated on the Drawings.

F. Suitable onsite excavated materials containing silty or slightly clayey to clayey fine sands shall be sufficiently dried by surface spreading and discing if necessary, or by mixing with cleaner fine sands prior to placement in fill areas.

G. Unsuitable materials within the influence area of construction shall be excavated,

removed from the site, and disposed, unless otherwise indicated on the Drawings.

H. Excavations shall be kept dry, compacted, and stable to a depth two feet below the bottom of the excavation.

I. If portions of the bottom of excavations consist of material unstable to such a degree that, in the opinion of the Engineer, it cannot adequately support the construction, the bottom shall be over excavated and stabilized with approved coarse granular stabilization material. Depth of stabilization shall be as directed by the Engineer. The initial 50 tons of stabilization shall be incidental to the Contract. Compensation will be allowed only for such additional quantities as the Engineer shall direct in writing to be placed.

3.05 FILLING

A. All fill material shall be suitable soils or flowable fill. Fill placed within 1 foot of structures shall not contain rock or stone larger than 2 inch diameter. If a sufficient quantity of suitable material is not available from other excavations within the site, provide additional suitable material or flowable fill.

B. Fill within the influence area of roadways, structures, foundations, or slabs, shall be placed in layers of 8 inch loose depth. In all other areas, place fill in layers of 12 inch loose depth.

C. Take necessary precautions not to cause settlement or damage to adjacent slabs, walls, structures, or foundations. Place fill materials evenly adjacent to structures, without wedging against structures.

D. Where filling is required on both sides of structures, fill and compact simultaneously on opposite sides in even layers.

3.06 COMPACTION

A. Unless otherwise indicated, the type of equipment and number of passes required to obtain the specified degree of compaction shall be determined at the site, subject to the approval of the Engineer.

B. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials, unless otherwise approved by the Engineer. Vibratory compaction is not allowed within 100 feet of existing structures. In these areas,

compaction shall be accomplished by static means only. If compaction difficulties arise, the Engineer shall be consulted to review and possibly modify compaction procedures.

C. Noncohesive soils shall be compacted with vibrating roller or equivalent; cohesive soils shall be compacted with sheeps-foot roller, pneumatic tamping, or approved equivalent, unless otherwise indicated.

D. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.07 TESTING AND CLEANUP

A. Provide for testing and cleanup as soon as practicable, so these operations do not lag far behind pipe installation. Perform preliminary cleanup and grading operations immediately after backfilling.

B. All unsuitable surplus excavated material shall be disposed of by the Contractor.

3.08 FIELD QUALITY CONTROL

A. Minimum Density Requirement (ASTM D1557 or AASHTO T180)

Fill under and within the influence area of roadways, structures, slabs, foundations = 98%

Pond and road embankment fill = 95%

Landscape areas = 85%

All other areas = 90%

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.01 SECTION INCLUDES

Dewatering design and operation requirements

1.02 RELATED SECTIONS

A. Section 31 25 00 - Erosion and Sedimentation Control

1.03 GENERAL REQUIREMENTS

A. Obtain the services of a qualified dewatering specialist to provide dewatering plan as may be necessary to complete the Work. Contractor shall be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system.

B. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. Design system to prevent differential hydrostatic head which would result in floating out soil particles in a manner termed as a “quick” or “boiling” condition. System shall not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation’s stability.

C. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow all Work to be installed in a dry condition.

D. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.

E. Contractor shall be responsible for and shall repair without cost to the Owner any damage to work in place, or other contractor’s equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation,

including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.

F. All dewatering shall be contained onsite and discharged into the percolation ponds. If the Contractor determines a more feasible option and discharges offsite, the Contractor shall be required to permit the dewatering system with the St. Johns River Water Management District or may operate under a current General Dewatering Permit issued from the District and shall schedule, coordinate, and pay for any groundwater testing required to obtain and operate under an approved permit. Contractor shall provide a copy the Permit and an operation plan showing compliance with the permit, including one turbidity test at a minimum. If an FDEP General Dewatering permit is used, the Contractor shall dispose of ground water in accordance with permit conditions. All required groundwater testing shall be performed by a firm specializing in testing groundwater at the expense of the Contractor.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Control by acceptable means all water regardless of source and be fully responsible for disposal of the water.

B. Confine discharge piping and/or ditches to available JEA property or easements or to additional easement obtained by Contractor.

C. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary for these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods. The water level as measured by piezometers shall be maintained a minimum of 3 feet below prevailing excavation level.

D. Commence dewatering prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.

E. Open pumping with sumps and ditches shall be allowed, provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes.

F. Install wells and/or wellpoints, if required, with suitable screens and filters, so that continuous pumping of fines does not occur. During normal pumping, and upon development of well(s), levels of fine sand or silt in the discharge water shall not exceed 5 ppm. Install sand tester on discharge of each pump during testing to verify that levels are not exceeded.

G. Control grading around excavations to prevent surface water from flowing into excavation areas.

H. Remove subgrade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Owner.

I. Walls shall not be exposed to water pressure before structural work at the next higher level has properly cured and the cantilever action of walls is eliminated.

3.02 MAINTAINING EXCAVATION IN DEWATERING CONDITION

A. Dewatering shall be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted.

B. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.

C. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.

D. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition.

3.03 SYSTEM REMOVAL

A. Remove dewatering equipment from the site, including related temporary electrical service.

B. Wells shall be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction.

END OF SECTION

SECTION 31 23 20

COMPACTION CONTROL AND TESTING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Specified Herein and Elsewhere

1. Work under this Section includes:

a. Placement, compaction controls, and fields density testing requirements for all earthwork, including pavement subgrade.

1.02 TESTING

A. Tests will be performed by an approved independent soils laboratory to insure adequate density is being obtained. The ENGINEER shall approve soils laboratory and designate where and when samples shall be taken, in accordance with soils report provided in the appendix. The Contractor will pay initial costs to make tests. The laboratory shall submit test reports to the ENGINEER and the Contractor.

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials and products are specified elsewhere in Division 31.

PART 3 EXECUTION

3.01 FILL PLACEMENT

A. Compacted material that has been flooded and no longer meets the density specified shall be removed, replaced and recompacted.

B. If the in-place surface has dried, sprinkle with water before placing the next lift. The surface of smooth lifts shall be scarified before the next lift is placed.

C. Where fill is required on both sides of structures, fill and compact simultaneously on opposite sides in even layers. Other filling sequences shall be as specifically indicated on the Drawings.

D. Fill shall be spread in uniform horizontal lifts. The material shall be thoroughly mixed to insure a uniform moisture content slightly wetter than optimum but not greater than 5 percent above optimum water content as determined by the Modified Proctor Test, ASTM D1557.

E. Where cohesive structural fill is used, the moisture content when compacted shall be within 3 percent of the optimum moisture content. If the fill does not have natural water content, which falls within the acceptable range, the Contractor shall mix, dry, or moisten as necessary.

F. Place and compact each lift over an entire area prior to placing successive lifts, unless otherwise approved by the ENGINEER.

G. All materials shall be placed in loose lift thicknesses indicated hereafter.

3.02 COMPACTION

A. General

1. Unless otherwise indicated, the type of equipment and number of passes required to obtain the specified degree of compaction shall be in accordance with the soils report and/or determined at the site, subject to the approval of the ENGINEER.

2. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials, unless otherwise approved by the ENGINEER.

B. Noncohesive soils shall be compacted with vibrating roller or equivalent; cohesive soils shall be compacted with sheeps-foot roller, pneumatic tamping, or approved equivalent, unless otherwise indicated.

3.03 FILL LIFT THICKNESSES AND COMPACTION DENSITIES

A. Unless otherwise indicated or approved by the ENGINEER, place fills in the loose lift thicknesses indicated hereafter, except when water jetting, and compact to a dry density not less than the following percentage of maximum dry density, determined by the Modified Proctor Test, ASTM D1557, unless otherwise noted.

3.04 TESTING

A. The Contractor shall assist in providing samples for the following field density tests to insure required densities are being obtained:

1. One test for each 3,000 lineal feet or fraction thereof per lift of general backfilling.

2. Two tests for each 10,000 square feet or fraction thereof per lift of structural fill under slabs, foundations, and pavements.

3. One test per lift for each other type of fill, if so directed by the ENGINEER.

B. Tests shall be in accordance with ASTM D1557 or other tests suitable for the materials being tested.

C. The Contractor will pay for initial field density tests. Subsequent tests and associated costs necessitated as a result of the initial tests failing to meet specified requirements will be at the expense of the Contractor.

TYPE OF FILL	USAGE	THICKNESS	REQ'D % OF LIFT MODIFIED PROCTOR TEST
Trenched Pipe Bedding	Beneath piping	6"	95 D1557
Trenched Pipe Cover	Over and/or around piping	12"	95 D1557
Utilities Trench Backfill	"Influence area" beneath other piping or utility lines	8"	95 D1557

	"Influence area" beneath rigid paving and rail-road tracks.	12"	95 D1557
	"Influence area" beneath non-rigid paving	9"	95 D1557
	Adjacent to or under structures	9"	98 D1557
	Croplands, plant site, lawns and landscaped areas.	12"	85 D1557
Preloading	Soil stabilization	12"	85 D1557
Structural Fill	All locations under major structures and all lagoon structures.	12"	98 D1557
	All locations under minor structures (manholes, etc.)	12”	95 D1557

Impermeable Fill	All locations	6"	98 D1557
Granular Fill	Below concrete slab bedding, foundations, rigid paving, and excavated areas adjacent to structures	12"	98 D1557
	All other uses	12"	85 D1557
Granular Bedding	Beneath concrete slabs	6"	95 D1557
Granular Drainage Blanket	Below concrete slabs, paving, or piping	9"	95 D2049
	All other uses	12"	85 D2049
Granular Filter	Around open joint or perforated drain pipes And at pressure relief valves	9"	95 D1557
Structural Backfill	See Trench Backfill		

General Site Grading	Lagoon Embankment	8"	95 D1557
	Lagoon bentonite - soil mixtures	--	95 D1557
	Fill for abandoned or demolished structures	12"	85 D1557
	Fill in other locations not covered herein	12"	85 D1557
	Topsoil placement	12"	85 D1557

"Influence area" shall be considered the area within lines sloped downward at 45 degrees from the outer edges of paving, foundations, and utility lines.

END OF SECTION

SECTION 31 23 33

TRENCHING, BEDDING, AND BACKFILLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Trenching for piping and electrical work.

B. Excavation for manholes, junction boxes, meter vaults, and appurtenances.

C. Sheeting, shoring and bracing

D. Bedding, backfilling, and compaction.

1.02 RELATED SECTIONS

A. Section 31 11 00 - Site Preparation

B Section 31 23 20 - Compaction Control and Testing

C. Section 31 22 00 - Finish Grading

D. Section 31 25 00 - Erosion and Sedimentation Control

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:

1. AASHTO M145 - Classification of Soils

2. AASHTO T180 - Moisture-Density Soil Sampling and Testing

American Society for Testing and Materials (ASTM) latest edition:

1. ASTM D1557 - Moisture-Density Soil Sampling and Testing

2. ASTM D2487 - Classification of Soils

1.04 DEFINITIONS

A. Bedding = Area from bottom of trench to centerline of pipe

B. Backfill = material above the top of pipe to the topsoil, paving sub-grade, or foundation level.

Influence Area = the area within lines sloped downward at 45 degrees from the outer edges of paving, foundations, and utility lines.

1.05 QUALITY ASSURANCE

A. Field density testing frequencies:

1. One test for each 150 lineal feet or fraction thereof per lift of general backfilling in the pipeline trench.

2. One test for each 100 square feet or fraction thereof of backfill around and under structures.

3. One test per lift per each change in type of fill.

1.06 PRECONSTRUCTION REQUIREMENTS

Precondition surveys and vibration monitoring are required for those areas where residential structures are within 100 feet of the proposed construction.

PART 2 PRODUCTS

2.01 GENERAL

It is intended that previously excavated materials conforming to the following requirements be utilized wherever possible.

2.02 MATERIALS

A. Suitable materials: AASHTO M145 classification A-3; ASTM D2487 classification GW, GP, SW, SP, SP-SM; unless otherwise disapproved within the Soil and Subsurface investigation reports. No more than 12% of acceptable materials shall pass the number 200 sieve.

B. Unsuitable materials: All materials other than those listed above.

C. Controlled low strength material ("flowable fill") shall meet the requirements of FDOT specification sections 121-1, 121-2, 121-3, 121-4, 121-5, and 121-6, except the range of acceptable 28-day compressive strength (as defined in 121-3) shall be revised to 75-100 psi.

2.03 SHEETING, SHORING, AND BRACING

A. The structural strength and safety of all sheeting, shoring and bracing shall be the sole responsibility of the Contractor. Repair any damage resulting from failure to provide adequate supports.

B. Provide timber work, shoring, bracing, sheeting, and sheet piling where necessary to retain banks of excavations, prevent cave-in of adjacent ground, prevent displacement of utilities and structures, and to protect public safety.

C. Contractor is solely responsible for the design, installation, and operation of dewatering systems and their safety and conformity with local codes and regulations.

PART 3 EXECUTION

3.01 GENERAL CONSTRUCTION REQUIREMENTS

A. Provide suitable temporary drainage channels for any water that may flow along or across the work.

B. Provide barriers, warning lights and other protective devices at all excavations.

C. Sidewalks, roads, streets, and pavements shall not be blocked or obstructed by excavated materials, except as authorized by the Engineer, in which case adequate temporary provisions must be made for satisfactory temporary passage of pedestrians, and vehicles. Minimize inconvenience to public travel or to tenants occupying adjoining property.

D. Where necessary to place excavated material adjacent to buildings, erect barriers to keep earth at least 4 feet from such buildings. Earth deposited on lawns shall be promptly and carefully removed to preserve the turf. All trees, shrubs, etc., shall be protected. Boring and jacking shall be used, if necessary, except where ENGINEER permission is granted to remove trees and shrubs.

E. If open excavations cross existing rigid surfacing, the surfacing shall be removed for a width one foot beyond the anticipated edge of the excavation. The pavement break shall be sawed to insure a straight joint. Surface replacement shall match existing surfacing except as otherwise indicated on the Drawings. Where open excavation is allowed along or across public roadways, excavation, backfill, and surface replacement shall conform to the requirements of all permits

applicable thereto. In no case shall surface replacement edges bear on less than 12 inches of undisturbed soil.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Locate and identify existing utilities that are to remain and protect from damage.

C. Notify utility companies to remove or relocate utilities that are in conflict with proposed improvements.

D. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced as necessary by same.

3.03 SHEETING, SHORING, AND BRACING

A. Furnish, install, and maintain, without additional compensation, sheeting, bracing, and shoring support required to keep excavations within the easement provided, to support the sides of the excavation, and to prevent any movement which may damage adjacent pavements or structures, damage or delay the work, or endanger life and health. Voids outside the supports shall be immediately filled and compacted.

B. Sheeting, where required, shall be driven below the bottom of excavation so the lowest set of wales and struts are above the bottom of the excavation to allow necessary working room.

C. The Engineer may direct in writing that supports in trenches be cut off at any specified elevation, in which case Contractor shall be paid for the supports left in place.

D. Contractor may leave in place, to be embedded in the backfill of the excavation, any or all supports for the purpose of preventing injury to persons or property, whether public or private. However, no supports which are within 4' of the ground or pavement surface may be left in place without written permission of the Engineer. No extra payment will be made for supports left in place at the Contractor's option.

E. All supports not left in place shall be removed in such manner as to avoid endangering the piping, structures, utilities or property, whether public or private. All voids left by the withdrawal of sheeting shall be immediately filled and compacted.

F. The right of the Engineer to order supports left in place shall not be construed as creating an obligation on his part to issue such orders. Failure by the Engineer to exercise this right shall not relieve the Contractor from total liability for damages to persons or property resulting from the failure of the Contractor to leave in place sufficient supports to prevent any caving or moving of the ground adjacent to the excavation.

3.04 TRENCHING

A. All excavations shall be made by open cut unless otherwise indicated. Sides of trenches shall be kept as nearly vertical as possible from the trench bottom to a level of one foot above the top of the pipe.

B. Excavation of trenches shall not advance more than 50 feet ahead of completed pipe installation except as approved by the ENGINEER.

C. Excavate trenches to depth indicated or required for indicated flow lines and invert elevations.

D. Where rock is encountered, carry excavation 6 inches below scheduled elevation and backfill with a 6-inch layer of crushed stone or gravel prior to installation of pipe.

E. For pipes or conduit 5 inches or less, excavate to indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

F. For pipes or conduit 6 inches or larger, and other work indicated to receive subbase, excavate to subbase depth indicated, or, if not otherwise indicated, to 6 inches below bottom of work to be supported.

G. Except as otherwise indicated, excavate for pressure piping so top of piping is minimum 3 feet below finished grade.

H. Unsuitable excavated materials shall be removed from the site and disposed, unless otherwise indicated on the Drawings.

I. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

J. Trench bottoms shall be kept dry, compacted, and stable to a depth two feet below the bottom of the trench.

K. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 9 -12 inch clearance on each side of pipe or conduit.

L. If more than one pipe is to be installed in a trench, the pipes shall be spaced a minimum of one foot apart for pipes 4 inches and larger.

M. If portions of the bottom of trenches consist of material unstable to such a degree that, in the opinion of the Engineer, it cannot adequately support the pipe or structure, the bottom shall be over excavated and stabilized with approved coarse granular stabilization material. Depth of stabilization shall be as directed by the Engineer. The initial 10 tons of stabilization shall be incidental to the Contract. Compensation will be allowed only for such additional quantities as the Engineer shall direct in writing to be placed.

N. Do not backfill trenches until tests and inspections have been made.

3.05 TRENCH BACKFILLING

A. Following placement of pipe and inspection of joints, install tamped bedding material. Place bedding fill materials in layers of 6-inch loose depth.

B. All bedding and backfill material shall be suitable soils or flowable fill. Backfill material within 1 foot of pipe and appurtenances shall not contain rock or stone larger than 2-inch diameter. If a sufficient quantity of suitable material is not available from the trench or other excavations within the site, provide additional suitable material or flowable fill.

C. After completion of bedding and preliminary approval of piping and testing, the pipe shall be covered to a point one foot above the top of the pipe for the full trench width, placed in layers of 6-inch loose depth.

D. Place backfill over pipe. Where trench is within the influence area of roadways, structures, foundations, or slabs, place backfill in layers of 6-inch loose depth. In all other areas, place backfill in layers of 8-inch loose depth.

E. Take necessary precautions not to cause settlement or damage to adjacent slabs, walls, structures, or foundations. Place backfill and fill materials evenly adjacent to structures, without wedging against structures or displacement of piping or conduit.

3.06 MINOR STRUCTURAL EXCAVATION AND BACKFILLING

A. Minor structures are defined as manholes, junction boxes, inlets, valve vaults, and meter vaults. Do not excavate for any structure until that structure is scheduled for construction. Excavate only to the depth and dimensions necessary for the construction.

B. The bottom of all excavations shall be undisturbed earth unless otherwise indicated, and shall be approved by the Engineer before any subsequent work is started.

C. Excavations carried below depths indicated on the Drawings without the previous approval of the Engineer shall be filled with 2500-psi concrete or flowable fill to the correct level at the expense of the Contractor.

D. Maintain excavations in good order. If the bearing capacity of the foundation soils is reduced because the excavation is allowed to remain open prior to commencing work, the weathered soil shall be removed and replaced with 2500 psi concrete or flowable fill at the expense of the Contractor.

E. Do not backfill until new concrete has properly cured, coatings have been approved, and any required tests have been accepted.

F. Exercise care during backfilling operations to avoid any puncture, break or other damage to waterproofing systems, if any. Backfill adjacent to waterproofing in the presence of the Engineer.

G. Where backfilling is required on both sides of structures, backfill and compact simultaneously on opposite sides in even layers. Other backfilling sequences shall be as specifically noted.

3.07 COMPACTION

A. Unless otherwise indicated, the type of equipment and number of passes required to obtain the specified degree of compaction shall be determined at the site, subject to the approval of the Engineer.

B. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials, unless otherwise approved by the Engineer. Vibratory compaction is not allowed within 100 feet of existing structures. In these areas, compaction shall be accomplished by static means only. If compaction difficulties arise, the Engineer shall be consulted to review and possibly modify compaction procedures.

C. Noncohesive soils shall be compacted with vibrating roller or equivalent; cohesive soils shall be compacted with sheeps-foot roller, pneumatic tamping, or approved equivalent, unless otherwise indicated.

D. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.08 TESTING AND CLEANUP

A. Provide for testing and cleanup as soon as practicable, so these operations do not lag far behind pipe installation. Perform preliminary cleanup and grading operations immediately after backfilling.

B. All surplus excavated material shall be disposed of by the Contractor.

3.09 FIELD QUALITY CONTROL

A. Minimum Density Requirement (ASTM D1557 or AASHTO T180)

1. Fill under and within the influence area of roadways, structures, slabs, foundations = 98%
2. Pond and road embankment fill = 95%
3. Landscape areas = 85%
4. All other areas = 90%

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

Designing, providing, maintaining, removing temporary erosion and sedimentation controls.

1.02 REFERENCES

A. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction and Roadway and Traffic Design Standards, latest editions:

Index No. 102 - Baled Hay or Straw Barriers and Silt Fences

Index No. 103 - Turbidity Barriers

Specification 300 - Prime and Tack Coats for Base Courses

1.03 SUBMITTALS

Provide erosion control plan. Show types of erosion and sedimentation control, locations, inspection and maintenance plan.

PART 2 PRODUCTS

2.01 EROSION CONTROL

A. Seeding and Mulching

B. Sodding

C. Hydro-seeding

D. Coarse Aggregate

E. Prime Coat - Per FDOT Specification 300

2.02 SEDIMENTATION CONTROL

A. Silt Fence - Per FDOT Index No. 102

B. Floating Turbidity Barriers - Per FDOT Index No. 103

a. Hay Bales - Per FDOT Index No. 102

PART 3 EXECUTION

3.01 EROSION CONTROL

A. Establish erosion control measures within 48 hours of the completion of any clearing and grading activities.

B. Erosion control of areas to be paved shall meet the following:

1. Install subgrade and base course materials within 48 hours of the completion of grading activities.

2. Areas to receive asphalt shall receive erosion control measures no later than 48 hours after acceptance of base course. Temporary erosion control consists of placement of a bituminous prime coat and sanding the surface. Permanent erosion control consists of placement of the structural course.

3. Areas to receive concrete paving shall be either protected with a layer of FDOT coarse aggregate material or shall be paved within 48 hours of acceptance of the subgrade.

3.02 SEDIMENTATION CONTROL

A. Install prior to construction.

B. Inspect every two weeks during construction.

C. Remove any sediment build-up.

D. Repair and reinstall any damaged or missing sediment control measures. Install additional measures if inspection reveals additional sedimentation control is necessary.

E. Rough excavate and grade any proposed stormwater ponds at the start of site grading activities. Direct site runoff to the ponds to minimize runoff to offsite areas.

END OF SECTION

SECTION 31 31 16

TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Chemical soil treatment.

B. Site-applied termiticide for wood, steel, and concrete.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 – Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.03 REFERENCE STANDARDS

A. ASTM E1745 – Stanard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

B. Title 7, United States Code, 136 through 136y – Federal Insecticide, Fungicide and Rodenticide Act; 2006.

1.04 QUAITY ASSURANCE

A. Installer Qualifications: Company specializing in performing this type of work and:

1. Having minimum of three (3) years documented experience.

2. Licensed in the State in which the Project is located.

1.05 Warranty

A. See Section 01 78 00 – Closeout Submittals, for additional warranty requirements.

B. Provide five year installer's warranty against damage to building caused by termites.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

A. Toxicant Chemical: EPA (Title 7, United States Code, 136 through 136y) approved; synthetically color dyed to permit visual identification of treated soil.

B. Diluent: Recommended by toxicant manufacturer.

C. Manufacturers:

1. Bayer Environmental Science Corp; ____: www.backedbybayer.com/pest-management.

2. FMC Professional Solutions; ___: www.fmcprosolutions.com

3. Syngenta Professional Products; ___: www.syngentaprofessionalproducts.com

4. Substitutions: See Section 01 60 00 – Product Requirements.

D. Mixes: Mix toxicant to manufacturer's instructions.

2.02 SITE-APPLIED TERMITICIDE

PART 3 EXECUTION

3.01 APPLICATION – CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

D. Re-treat disturbed treated soil with same toxicant as original treatment.

E. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.02 INSTALLATION – SITE-APPLIED TERMITICIDE

3.03 PROTECTION

A. Do not permit soil grading over treated work.

B. Protect sheet materials from damage after complete installation. Repair damage with manufacturer's recommended products and according to the manufacturer's written instructions.

END OF SECTION

SECTION 32 92 10

GRASSING AND SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

Soil preparation, sodding, seeding, mulching, fertilizing, watering, and maintenance of grassed areas

1.03 WARRANTY

All seeding shall be warranteed by the General Contractor to be true to name and in a vigorous growing condition through one growing cycle including one summer and one winter season.

1.04 MAINTENANCE

Maintenance for lawns shall begin immediately after seeding or sodding. Provide watering, mowing and replanting and continue as necessary until a close healthy stand of specified grasses is established.

PART 2 PRODUCTS

2.01 LIME

Lime shall be agricultural grade dolomitic limestone, ground sufficiently fine so that at least 80 percent will pass through a No. 8 sieve, and it shall contain not less than 80 percent calcium carbonate equivalent. Moisture content at time of delivery shall not exceed 8 percent.

2.02 FERTILIZER

Fertilizer shall be a composition recommended by a local County Agricultural Agent or State Agricultural Extension Service or a pre-formulated 10-6-4 mixture.

2.03 WATER

Water shall be free from oil, acid, alkali, salts, and other harmful substances.

2.04 SOD

A. Sod shall be either field or nursery grown sod that is native to the locality of the Project. The Contractor shall obtain Engineer's approval of the source of the sod prior to cutting the sod.

B. Sod grown on soil high in organic matter, such as peat, will not be acceptable. The consistency of sod shall be such that it will not break, crumble or tear during handling and placing. Sod shall be reasonably free of stones, crab grass, noxious weeds, and other objectionable plants or substances injurious to plant growth.

C. Sod shall have at least 1-inch of soil adhering firmly to the roots and cut in rectangular pieces with the shortest side not less than 12-inches. At the time of cutting sod the grass shall be mowed to a height not less than 2-inches nor more than 4-inches.

D. Sod cut for more than 48 hours shall not be used without the approval of the ENGINEER.

F. Bahia Sodding - Argentine Bahia Sod

2.05 SEEDING AND MULCHING

A. Permanent grass seed shall be Argentine Bahia, in accordance with FDOT specification 981.

B. Temporary grass seed shall be annual rye grass in accordance with FDOT specification 981.

C. Mulch shall be dry organic mulch in accordance with FDOT specification 981.

PART 3 EXECUTION

3.01 REGRADING OF TOPSOIL

Topsoil shall be graded reasonably smooth and level after final settlement. All humps shall be removed and depressions or eroded areas filled in with additional topsoil before proceeding with seeding or sodding.

3.02 PREPARATION FOR SODDING OR SEEDING

A. Preparation shall not be started until all other site and utility work and finished grading within the areas to be seeded have been completed.

B. Loosen topsoil by tilling it to a depth of at least 3 inches and smooth out all surface irregularities resulting therefrom. Leave area free of rocks or hard soil clods, which will not pass through the tines of a standard garden rake.

C. At least 7 days before applying fertilizer, spread lime uniformly in sufficient quantity to produce in the soil a pH of 6.5. Work lime thoroughly into topsoil to a depth of 3-inches.

D. Apply fertilizer uniformly at a rate of 20 pounds per 1000 square feet. Work fertilizer into soil prior to seeding or sodding.

3.03 SODDING

A. Sodding shall also be used in ditches and drainage swales and on all embankment slopes unless protection is provided against erosion of seeding.

B. Place sod with the edges in close contact and alternate courses staggered. Lightly tamp or roll to eliminate air pockets. On slopes 2 to 1 or steeper, stake sod with not less than 4 stakes per square yard and with at least one stake for each piece of sod. Stakes shall be driven with the flat side parallel to the slope. Do not place sod when the ground surface is frozen or when air temperature may exceed 90 degrees. Water the sod thoroughly within 8 hours after placement and as often as necessary to become well established.

C. In ditches, the sod shall be placed with the longer dimension perpendicular to the flow of water in the ditch. On slopes, starting at the bottom of the slope, the sod shall be placed with the longer dimension parallel to the contours of the ground.

D. All exposed edges of sod shall be buried flush with the adjacent turf.

3.04 SEEDING AND MULCHING

A. Scatter seed uniformly over the grassing area while the soil is still loose and moist at the rate of 100 pounds per acre.

B. Seed of quick growing species of grass, such as rye, fescue or Argentine Bahia, shall be spread in conjunction with the permanent-type seed mixture. The type of quick-growth seed used shall be appropriate to provide an early ground cover during the particular season when planting is done. The rate of spread shall be 30 pounds per acre, unless otherwise specified.

C. Apply approximately 2 inches, loose thickness, of the mulch material uniformly over the seeded area, and cut into the soil so as to provide an early ground cover during the particular season when planting is done. The rate of spread shall be 30 pounds per acre, unless otherwise specified.

D. Rolling: Roll thoroughly the entire seeded area immediately after completion of the seeding.

3.05 WATERING

Immediately after placing erosion control or mulch, water seeded areas thoroughly with a fine mist spray. Keep soil thoroughly moist until seeds have sprouted and achieved a growth of 1 inch. For sod, immediately begin watering and continually keep moist, for a minimum of 90 days or until the sod has firmly knit itself to the topsoil.

3.06 PROTECTION OF WORK

Protect newly seeded and sodded areas from all traffic by erecting temporary fences and signs. Protect slopes from erosion. Properly and promptly repair all damaged work when required.

3.07 APPLICATION OF FERTILIZER

Six weeks after completion of seeding or sodding apply granular fertilizer over all areas at the rate of two pounds of nitrogen nutrients per 1000 square feet of area.

3.08 CLEAN-UP

At the time of final inspection of work, but before final acceptance, remove from seeded and sodded areas all debris, rubbish, excess materials, tools, and equipment.

3.09 LAWN REPLACEMENT

Lawns not showing a close uniform stand of healthy specified grasses at the end of the guaranty period shall be replaced and maintained until acceptance. Scattered bare spots, none of which is larger than one square foot, will be allowed up to a maximum of 1% of the total area.

END OF SECTION

SECTION 40 05 00

GENERAL PIPING REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

This section describes the application of the piping shown in the drawings and the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).

C. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

D. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

1.03 DEFINITIONS OF BURIED AND EXPOSED PIPING

A. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure. Where a coating is specified, provide the coating up to the structure wall. Unless detailed otherwise, coating shall penetrate wall no less than 1 inch. Piping encased in concrete is considered to be buried. Do not coat encased pipe.

B. Exposed piping is piping in any of the following conditions or locations:

1. Above ground.

2. Inside buildings, vaults, or other structures.

3. In underground concrete trenches or galleries.

1.04 PIPING SERVICE

Piping service is determined by the fluid conveyed, regardless of the pipe designation. For example, pipes designated "Air Low Pressure," "Air High Pressure," and "Air" are all considered to be in air service.

1.05 DEFAULT PIPING MATERIALS

If no material is shown in the drawings or specified in JEA Standards Manual, use the following piping materials:

Service	Size Range (inches)	Material	Specification Section
Buried	3 and smaller	SCH80 PVC	40 20 90
	4	Ductile Iron	40 20 40
	6 and larger	Ductile Iron	40 20 40
Exposed	3 and smaller	316 Stainless Steel	40 20 76
	4	316 Stainless Steel	40 20 76
	6 and larger	316 Stainless Steel	40 20 76

PART 2 MATERIALS

2.01 MATERIALS SELECTION AND ALTERNATIVE MATERIALS

A. Materials called out in the drawings shall govern over materials stated in the Piping Schedule.

B. Alternative piping materials for certain services may be shown. In such cases, the same pipe material shall be used for all pipe sizes in all locations for the given piping service. Do not intermix piping materials.

2.02 THREAD FORMING FOR STAINLESS STEEL BOLTS

Form threads by means of rolling, not cutting or grinding.

2.03 BOLTS AND NUTS FOR FLANGES FOR DUCTILE-IRON PIPING (SPECIFICATION SECTIONS, 40 20 40)

A. Bolts and nuts for Class 125 or 150 flanges (including AWWA C207, Class D) located indoors, outdoors above ground, and in vaults and structures shall be carbon steel, ASTM A307, Grade B, hot-dipped galvanized per ASTM F2329.

B. Bolts and nuts for buried or submerged Class 125 or 150 flanges shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

C. Hex head machine bolts for use with lugged valves shall comply with ASTM A193, Grade B7.

D. Fit shall be Classes 2A and 2B per ASME B1.1 when connecting to cast-iron valves having body bolt holes.

E. Bolts for AWWA C207 Classes E and F flanges and ASME B16.5 and B16.47 Class 300 flanges located indoors, outdoors above ground, and in vaults and structures shall conform to ASTM A193, Grade B7, with nuts conforming to ASTM A194, Grade 2H.

F. Bolts and nuts for buried or submerged Class 300 flanges shall be Type 304 stainless steel conforming to ASTM A193, Grade 8, Class 2, for bolts and ASTM A194, Grade 8 for nuts.

G. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

H. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.04 BOLTS AND NUTS FOR FLANGES FOR STAINLESS STEEL PIPING (SPECIFICATION SECTION 40 20 76)

A. Bolts and nuts for flanges shall be Type 304 stainless steel conforming to ASTM A193, Grade B8 for bolts and ASTM A194, Grade 8 for nuts.

B. Hex head machine bolts for use with lugged valves shall comply with ASTM A193, Grade B8, Class 2.

C. Bolts for flange insulation kits shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H.

D. Provide washer for each nut. Washers shall be of the same material as the nuts.

2.05 BOLTS AND NUTS FOR FLANGES FOR PVC PIPE (SPECIFICATION SECTION 40 20 90)

A. Bolts and nuts for flanges located indoors, outdoors above ground, and in vaults and structures shall be carbon steel, ASTM A307, Grade B, hot-dipped galvanized per ASTM F2329.

B. Bolts and nuts for buried and submerged flanges shall be Type 304 stainless steel conforming to ASTM A193, Grade B8 for bolts and ASTM A194, Grade 8 for nuts.

2.06 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Husky™ Lube O'Seal, or equal.

2.07 GASKETS FOR FLANGES FOR PVC (SPECIFICATION SECTION 40 20 90)

Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material for other than sodium hypochlorite service shall be EPR. Gasket material for sodium hypochlorite service shall be Viton ETP.

2.08 GASKETS FOR FLANGES FOR STAINLESS STEEL PIPING (SPECIFICATION SECTION 40 20 76)

Gaskets shall be full face, 1/8-inch thick. Gaskets for services other than chemical service shall be one of the following nonasbestos materials:

A. Cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a pressure of 200 psi at a temperature of 180°F. Products: Garlock Style 19 or equal.

B. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400°F.

2.09 MOLDABLE FILLER TAPE FOR PIPE SURFACE TRANSITION AREAS

A. Filler tape shall be a 100% solids mastic-like butyl-rubber filler designed to fill and smooth the transition areas between adjacent coating surfaces such as step-down weld areas, surface irregularities beneath heat-shrink sleeves, pipefittings, and exothermic welds for cathodic protection bonding wire connections. Characteristics:

1. Thickness per ASTM D1000: 1/8 inch minimum.
2. Peel adhesion to primed pipe: 300 ounces per inch minimum.
3. Elongation: 600% minimum.

B. Products: Tapecoat “Moldable Sealant,” Polyken No. 939 Filler Tape, or equal.

2.10 FLANGE INSULATION KITS

A. Flange insulation kits shall consist of insulating gasket, an insulating stud sleeve for each bolt, insulating washers for each bolt, and a steel washer between each insulating washer and the nut. The sleeves shall be one piece, integral with the insulating washer. Provide double sleeve and washer sets for each bolt.

B. Gasket material shall be phenolic, 1/8-inch (3 mm) thick. The flange insulating gasket shall be full diameter (full face) of the flange with a nitrile O-ring on each side of the gasket. Dielectric strength shall be not less than 500 volts per mil (0.025 mm) and a compressive strength of not less than 24,000 psi (165,000 kPa).

C. Insulating flange bolt sleeves shall be spiral-wrapped mylar having a minimum dielectric strength of 4,000 volts per mil (0.025 mm).

D. Insulating flange bolt washers shall be high-strength phenolic a minimum thickness of 1/8-inch (3 mm). Dielectric strength shall be not less than 500 volts per mil (0.025 mm) and a compressive strength of not less than 25,000 psi (172,000 kPa).

E. Steel flange bolt washers for placement over the insulating washers shall be a minimum thickness of 1/8-inch (3 mm) and be zinc plated or stainless steel.

F. Flange insulation kits shall be as manufactured by Advance Product Systems, PSI, Central Plastics Company, or equal.

2.11 INSULATING UNIONS

A. Insulating unions shall consist of a molded nylon sealing sleeve mounted in a three-piece malleable-iron (ASTM A47 or A197) body. Ends shall be threaded (ASME B1.20.1) when connecting to steel piping and copper solder joint when connecting to copper piping. Minimum working pressure shall be 150 psi (1034 kPa). Unions shall be as manufactured by Central Plastics Company, Capital Insulation, or equal.

PART 3 EXECUTION

3.01 INSTALLING PIPE SPOOLS IN CONCRETE

Install pipes in walls and slabs before placing concrete. See Sections 03 30 00 and 40 07 62.

3.02 RAISED FACE AND FLAT FACE FLANGES

Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

3.03 INSTALLING ABOVEGROUND OR EXPOSED PIPING

A. Provide pipe hangers and supports as detailed in the drawings and as specified in Section 40 07 64.

B. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

3.04 INSTALLING FLANGED PIPING

A. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within

1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

B. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

C. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

D. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

E. Do not use more than one gasket between contact faces in assembling a flanged joint.

F. Tighten the bolts to the manufacturer's specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.05 INSTALLING BLIND FLANGES

A. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.

3.06 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

SECTION 40 05 15

PRESSURE AND LEAKAGE TESTING OF PIPING

PART 1 GENERAL

1.01 DESCRIPTION

Work Specified Herein and Elsewhere

A. Work under this Section includes:

1. Piping system testing.
2. Leakage tests.
3. Testing equipment.
4. System testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide all necessary equipment and instrumentation required for proper completion of testing. Source and quality of water shall be approved by the Engineer.

B. The CONTRACTOR shall pretest all piping systems prior to scheduling a final test. The time and expense associated with any retesting shall be the responsibility of the CONTRACTOR, including the time and expense of the ENGINEER's representative witnessing the retest.

PART 3 EXECUTION

3.01 PIPING SYSTEM TESTING

A. General Requirements

1. Test procedures and method of disposal of water shall be approved by the Engineer. All tests shall be made in the presence of the JEA tests made by the CONTRACTOR without being observed by the Engineer will not be accepted. Notify the JEA at least twenty-four (24) hours before any work is to be inspected or tested.

2. All defects in piping systems shall be repaired and/or replaced and retested until acceptable. Repairs shall be made to the standard of quality specified for the entire system.

3. Sections of the system may be tested separately, but any defect which may develop in a section previously tested and accepted shall be promptly corrected and retested. Pressure tests shall be made between valves to demonstrate ability of valves to sustain pressure.

4. All piping shall be tested in accordance with the following test methods, in addition to any test required by local and state codes or building authorities.

B. Flushing

Prior to testing, flush all piping systems with water to remove construction debris.

C. Pressure Piping Testing

1. All piping subject to 5 psig pressure or more shall pass the following hydrostatic pressure test and leakage test.

2. Tests for any exposed piping shall be made before covering and insulation is placed.

3. The pressure and leakage test for buried piping shall be made after all jointing operations are completed and any concrete reaction blocks, and restraints have cured at least seven days. Lines tested before backfill is in place shall be retested after compacted backfill is placed.

4. Sections of piping between valves and other short sections of line may be isolated for testing. If shorter sections are tested, test plugs or bulkheads required at the ends of the test section shall be furnished and installed by the CONTRACTOR, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure without imposing any thrust on the pipe line. The CONTRACTOR shall be solely responsible for any damage which may result from the failure of test plugs or supports.

D. Hydrostatic Tests for Pressure Piping

1. Piping shall be slowly filled with water and all air expelled. Care shall be taken that all air valves are installed and open in the section being filled, and that the rate of filling does not exceed the venting capacity of the air valves.

2. After the section of line to be tested has been filled with water, the specified test pressure shall be applied and maintained for a minimum period of 10 minutes and for such additional period necessary for the ENGINEER to complete the inspection of the line under test. Do not exceed pipe manufacturer's suggested time duration at the test pressure. If defects are noted, repairs shall be made and the test repeated until all parts of the line withstand the test pressure.

3. Hydrostatic test pressure shall be as determined by the ENGINEER.

E. Leakage Test for Pressure Piping

1. After the specified hydrostatic test has been completed, the line shall be subjected to a leakage test under a hydrostatic pressure in the range of 50% to 100% of the pressure required for the hydrostatic test. The selected pressure shall be maintained within a maximum variation of 5% during the entire leakage test. The duration of the leakage test shall be two hours minimum, and for such additional time necessary for the Engineer to complete inspection of the section of line under test. Leakage measurements shall not be started until a constant test pressure has been established. The line leakage shall be measured by means of a water meter installed on the supply side of the pressure pump.

2. No leakage is allowed in exposed piping, buried piping with flanged, threaded, or welded joints or buried non-potable piping in conflict with potable water lines.

3. Tested sections of buried piping with slip-type or mechanical joints will not be accepted if it has a leakage rate in excess of that rate determined by the formula:

   L = 0.00027 NDp, in which;

   L = Maximum permissible leakage rate, in gallons per hour, throughout the entire length of line being tested.

   N = Number of gasketed joints (two for each flexible coupling joint) in the line under test.

   D = Nominal internal diameter (in inches) of the pipe.

   p = The square root of the actual pressure in psig on all joints in the tested portion of the line. This actual pressure shall be determined by finding the difference between the average elevation of all tested pipe joints and the elevation of the pressure gauge and adding the difference in elevation head to the authorized test pressure.

3. Where the leakage rate exceeds the permissible maximum, the CONTRACTOR shall locate and repair leaking joints to the extent required to reduce the total leakage to within the prescribed amount.

4. All apparent leaks discovered within one year from the date of final acceptance of the work by the OWNER shall be located and repaired by the CONTRACTOR, regardless of the total line leakage rate.

END OF SECTION

SECTION 40 05 20

MANUAL, CHECK, AND PROCESS VALVES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of manually operated valves, check valves, and process valves including gate, knife gate, butterfly, ball, hose bibbs, globe, angle, needle, eccentric plug, lubricated plug, nonlubricated plug, diaphragm, check, pinch, solenoid, pet cocks, mud valves, vacuum breakers, deluge valves, flap valves, balancing valves, gauge valves, instrument valve manifolds, and telescoping valves.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

C. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

D. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

E. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."

PART 2 MATERIALS

2.01 GENERAL

A. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

B. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

C. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

2.02 VALVE ACTUATORS

A. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

C. Provide 2-inch AWWA operating nuts for buried and submerged valves. Provide 2-inch AWWA operating nuts with the handwheels for manually actuated valves 24 inches and larger for use with a portable electric valve actuator.

D. Provide enclosed gear actuators on butterfly, ball, and plug valves 6 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators for valves 6 through 20 inches shall be of the worm and gear, or of the traveling nut type. Gear actuators for valves 24 inches and larger shall be of the worm and gear types.

E. Provide gear actuators on gate valves 14 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators shall be of the bevel or spur gear type. Provide grease case. Gearing shall comply with AWWA C500.

F. Design gear actuators assuming that the differential pressure across the plug, gate, or disc is equal to the test pressure of the connecting piping and assuming a

fluid velocity of 16 fps for valves in liquid service and 80 fps for valves in air or gas service and a line fluid temperature range of 33°F to 125°F unless otherwise required in the detailed valve specifications. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.

G. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

H. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

I. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

J. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

K. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B84, Alloy C86200), accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148, Grade 105-85), with thread ground and polished. Support worm-gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run

in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

L. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

M. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.03 CAST-IRON VALVE BOXES WITH DEBRIS CAPS FOR BURIED VALVES

A. Valve boxes shall be two-piece sliding type, cast iron, with extension shafts. Units shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal. Extension pipes shall be cast iron.

B. Debris cap shall be comprised of a hollow member having a cylindrical outer surface, a closure for one end, and three resilient contact pads projecting from the outer surface. Stainless steel springs under each contact pad shall hold the debris cap in position against the interior of the extension pipe or valve box. Provide handle to allow the contact pads to be extended and retracted. The cap shall have a flexible skirt providing an outward seal preventing debris from passing the cap. The cap shall withstand, without slipping, a minimum vertical force of 50 pounds when the contact pads are extended against the wall of the extension pipe or valve box. The cap shall be made of molded ABS plastic material. Color of handle shall be red. The cap shall have retaining prongs to retain a copper locating wire coil. Manufacturer: SW Services, Phoenix, Arizona, or equal.

C. Coat buried cast-iron pieces bituminous asphaltic coating or with fusion-bonded epoxy per Section 099761.

2.04 EXTENSION STEMS FOR BURIED AND SUBMERGED VALVE ACTUATORS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall

withstand without damage a pull of 300 foot-pounds.

B. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1 1/8
10, 12	1 1/4
14	1 3/8
16, 18	1 1/2
20, 24, 30, 36	1 3/4
42, 48, 54	2

C. Provide buried valves or valves located inside manholes or vaults with valve boxes cast in the manhole or vault roof with a valve position indicator designed to fit standard 5-1/4-inch valve boxes. The indicators shall show valve position and the direction and number of turns required to fully open (or close). All internal gearing shall be sealed. Ship each unit ready for field installation complete with valve box cast-iron adapter, cap screws, guide bushing, position indicator, flexible washer, centering plate, and 2-inch AWWA nut. Valve box and indicator shall be provided by the valve manufacturer. Indicators shall be Westran Position Indicator, Pratt Diviner, or equal.

2.05 FLOOR STANDS, EXTENSION STEMS, AND EXTENSION STEM SUPPORT BRACKETS

A. When required by the installations, provide floor stands and extension stems for operation of valves. Floor stands shall be of the nonrising stem, indicating type,

complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.

B. Provide Type 316 stainless steel anchor bolts.

C. Provide Type 316 stainless steel extension stems.

D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be ductile iron. Coat ductile iron components with fusion-bonded epoxy per Section 099761. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

2.06 VALVE TAGGING AND IDENTIFICATION

Provide identifying valve tags per Section 40 07 75.

2.07 BOLTS AND NUTS FOR FLANGED VALVES

Bolts and nuts for flanged valves shall be as described in Section 40 05 00.

2.08 GASKETS FOR FLANGES

Gaskets for flanged end valves shall be as described in Section 40 05 00.

2.09 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09 90 00. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field. Finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.

B. Coat buried metal valves at the place of manufacture per Section 099000, System No. 30.

C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 09 90 00.

D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09 90 00. Apply lining at the place of manufacture. All linings to be NSF61 approved.

E. Alternatively, line and coat valves with fusion-bonded epoxy per Section 099761.

F. Coat floor stands per Section 09 90 00.

G. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

2.010 PACKING, O-RINGS, AND GASKETS

Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

A. Teflon.

B. Kevlar aramid fiber.

C. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

D. Buna-N (nitrile).

2.011 RUBBER SEATS

Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

2.012 LOCATING MARKERS

Provide magnetic locating ball at each valve location.

2.013 VALVES

A. Gate Valves:

a. Ductile-Iron Resilient Wedge Tapping Gate Valves 4 Inches Through 16 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. Ends shall be flanged, Class 125, ASME B16.1. One end shall have slotted bolt holes per AWWA C515, paragraph 4.4.1.3.4 to fit tapping machines.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils. Valves shall be certified to NSF/ANSI Standard 61.

Manufacturers: American Flow Control (2500 Series), AVK s/s stem only (Series 45), Clow (F-6100), Kennedy (8571), M&H (4067), Mueller (A2360, A2361), U.S. Pipe (250), United Water (2010), Mueller –Aqua Grip (A-2361-77), American RD (D100)

b. Stainless Steel Gate Valves:

Stainless steel gate valves, 1/2 through 2 inches, shall be of the single wedge type with rising stem and handwheel. Minimum working pressure shall be 200 psig. Bonnet shall be of the screwed type. Ends shall be threaded, ASME B1.20.1. Materials of construction shall be as follows:

Component	Material	Specification
Body, bonnet, plug, disc, and follower	Stainless steel	ASTM A351, Grade CF8M
Packing gland, nut, retainer ring, and stem	Stainless steel	ASTM A276, Type 316
Handwheel	Malleable iron	ASTM A47, A197
Stuffing box packing	Teflon	--

Valves shall be Powell Figure 1832, Crane/Alloyco Figure 90, or equal.

B. Ball Valves:

a. Full Port Threaded Bronze Ball Valves 2 Inches and Smaller:

Ball valves, 2 inches and smaller, for air or water service shall have a pressure rating of at least 600 psi WOG at a temperature of 100°F. Provide full port ball and body design. Valves shall comply with MSS SP-110. Provide bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug ball retainer. Ball and stem shall be Type 316 stainless steel. Valves shall have threaded ends (ASME B1.20.1), nonblowout stems, reinforced Teflon seats, and have plastic-coated lever actuators. Valves shall be Stockham S-216 Series, Powell Fig 4210 T, Conbraco Ind. Apollo 7-100 Series, or equal.

b. Double Union PVC Ball Valves 3 Inches and Smaller:

Thermoplastic ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VK or VKD, or equal.

c. Double Union PVC Ball Valves 3 Inches and Smaller with Vented Ball for sodium hypochlorite service:

Vented PVC ball valves, 3 inches and smaller, for chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F. Provide machined vent hole, deburred, in the ball to allow gases to vent. The vent hole shall be part of the manufactured valve assembly. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton and suitable for the intended service. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Provide stem extensions when valves are installed in insulated piping. Stem extensions shall be of a length sufficient to bring the bottom of the operating handle above the outside of the insulation. Products: Valves shall be Plast-O-Matic "Z-MBV-Vent," Asahi/America Type 21, or equal.

d. Regular Port Threaded Stainless Steel Ball Valves 2 Inches and Smaller:

Stainless steel ball valves, 2 inches and smaller, for water service shall be rated at a minimum pressure of 1,500 psi WOG at a temperature of 100°F. Valve body, ball, and stem shall be Type 316 stainless steel, ASTM A276 or A351. Seat and seals shall be reinforced Teflon. Valves shall have lever actuators, plastic coated. Provide locking lever handle. Valves shall have threaded ends (ASME B1.20.1) and nonblowout stems. Valves shall be McCanna Figure M402, Worcester Series 48, Stockham Figure SD 2120-SSMO-R-T, Apollo 76-100 Series, or equal.

C. Check Valves:

a. Check Valves (Rubber Flapper):

Check valves shall conform to AWWA C508. Check valves larger than 2-inch nominal size shall be iron body with stainless steel bolts and nuts, flanged ends, outside lever, spring loaded (stainless steel spring if available), swing-type with straight-away passageway of full pipe area. The valve shall have renewable bronze seat ring and rubber faced disc. Check valves shall

be 150 psi working pressure. Valves shall be GA FLG 200 with limit switch or Valmatic 500 series with limit switch.

b. Polypropylene Ball Check Valves, 3 Inches and Smaller:

Polypropylene check valves, 3 inches and smaller, shall be constructed of Polypropylene per ASTM D4101, Cell Classification PP0210B67272. Ends shall be double union, socket welded. Seats and seals shall be Teflon or EPDM. Valve shall have a pressure rating of 150 psi at a temperature of 73°F. The valve shall be U.S. Plastic Corp., George Fischer Type 360 or equal.

c. PVC Ball Check Valves, 3 Inches and Smaller:

PVC check valves, 3 inches and smaller, shall be constructed of PVC per ASTM D1784, Type I, Grade 1. Ends shall be double union, socket welded. Seats and seals shall be Viton for sodium hypochlorite, EPDM for other water services. Valve shall have a pressure rating of 150 psi at a temperature of 73°F.

d. Duckbill-Shaped Check Valves, 1 Through 3 Inches, slip-on:

Valve shall consist of a contoured rubber body with a duckbill sleeve-type exit. The valve shall be installed by slipping over the end of an exposed piece of pipe, and is fastened with compression clamps. The inside diameter of the valve's cuff shall be fabricated to exactly match the outside diameter of the pipe. The valve shall have a flare on the top and bottom. Material of construction of Hypalon Coated valves shall be EPDM for hydrofluosilicic acid and Viton for sodium hypochlorite applications. Provide Type 316 stainless steel compression clamp. The valve shall open at a differential pressure of 2 inches of water column and shall close under a no-flow condition. Products: Red Valve Company "Tideflex" Modified Series TF-2 or equal.

e. Sample Valve

Sample valve shall have 316 stainless steel body with quarter turn level handle and plain (unthreaded) outlet. It shall be NSF61 certified. Valve shall be ½-inch diameter with renewable seats. Valve shall be self-closing. Unit shall be Chicago Faucet Co. or equal.

D. Plug Valves:

All plug valves, unless specifically shown otherwise on the drawings, shall be of non-lubricated, eccentric plug type with Buna “N” neoprene, epoxy or fusion bonded, nylon faced plugs. Valve bodies shall be ASTM A126, Class B cast iron with all exterior mounted bolts and nuts to be stainless steel. Port areas of 4 inch through 20 inch valves shall be at least 80% full pipe area and 24 inch and larger calves shall be at least 70% full pipe area. The valve seat material shall consist of either a welded in 1/8 inch overlay of 90% pure nickel, or 316 stainless steel screwed into the cast iron body. Upper and lower plug stem bearings shall be sleeve-type of a stainless steel or other non-corrosive bearing material. The packing shall be adjustable and the bonnet shall be bolted. All bots, nuts, washers shall be 316 stainless steel for buried, non-buried, and pit installed service. All buried valves on push-on joint pipe shall have mechanical joint ends and meet the requirements of ANSI A21.11. All exposed (non-buried) valves shall have flanged ends in accordance with American Standard B16.1, Class 125. The valves shall be rated for a minimum of 150 psi, non-shock cold B16.1, Class 125. The valves shall be rated for a minimum of 150 psi, non-shock cold W.O.G and shall provide drip-tight shut off with this pressure in either direction. The operating nut or hand wheel shall have an arrow cast in the metal indicating direction of opening. The valve manufacturer shall furnish certified copies of performance, leakage and hydrostatic testing as outlined in AWWA C504. The interior of all plug valves shall be epoxy coated. Products: Clow Valve/Kennedy, Dezurik, TYCO/Keystone Eccentric, Milliken Valve or Mueller Water Products 600 N (MJ)/601 N (FLG), Henry Pratt Co, Val-Matic.

E. Air Release Valves:

Air release valve shall be automatic float operated, all 316 stainless steel body and trim and fasteners. A check valve on the outlet is required to prevent air from re-entering the pressurized water main. Acceptable Air Valve Manufacturers: Valmatic and H-TEC.

F. Backflow Prevention Devices

Backflow prevention device shall comply with JEA's construction detail and shall be a JEA Approved product.

G. Pressure Gauges

Pressure gauges shall be by Bristol Babcock-Helicoid 900 series. Refer to Section 40 95 00 for Pressure Indicator Transmitter requirements.

PART 3 EXECUTION

3.01 VALVE SHIPMENT AND STORAGE

A. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at the place of valve manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures. Alternatively, ship flanged valves 3 inches and smaller in separate sealed cartons or boxes.

B. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping. Alternatively, ship valves having threaded openings or end connections in separate sealed cartons or boxes.

C. Store resilient seated valves in sealed polyethylene plastic enclosures with a minimum of one package of desiccant inside. Store resilient seated valves in the open or unseated position. Valves with adjustable packing glands shall have the packing gland loosened prior to storage. Inspect valves at least once per week, replace desiccant if required and repair damaged storage enclosures. Do not store valves with resilient seats near electric motors or other electrical equipment.

D. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around operating shaft, actuator, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.

E. Protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.

F. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the actuator to the valve for loosening in transit and handling. If loose, tighten firmly. Open and close valves having manual or power actuators to make sure the valve operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close valve before installing.

3.02 FACTORY PRESSURE TESTING

A. Hydrostatically test the valve pressure-containing parts at the factory per the valve specification or per the referenced standard. If no testing requirement is otherwise specified or described in the referenced standards, then test with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, then provide an additional operational test and verify that the valve components function.

B. The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 ppm. To prevent deposition of chlorides as a result of evaporative drying, remove residual liquid from tested parts at the conclusion of the test.

3.03 INSTALLING VALVES--GENERAL

A. Remove covers over flanged openings and plugs from threaded openings, after valves have been placed at the point to which the valves will be connected to the adjacent piping. Do not remove valves from storage cartons or boxes until they are ready to be installed.

B. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault or building walls, or trench walls.

C. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer’s instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

D. Make sure valve ends and seats are clean. Check exposed bolting for loosening in transit and handling and tighten to manufacturer’s recommendations. Open and close the valve to make sure it operates properly and that stops or limit switches are

correctly set so that the vane, ball, gate, needle, diaphragm, disc, plug, or other seating element seats fully. Close the valve before installing. Check coatings for damage and repair. Handle valves carefully when positioning, avoiding contact or impact with other equipment or structures.

E. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

3.04 INSTALLING EXPOSED VALVES

A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.05 INSTALLING BURIED VALVES

A. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement, and place and compact the backfill to the height of the valve stem.

B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.

C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.

D. In streets without concrete curbs and in open areas, install the valve box as for a paved area with concrete curb except include a marker post. Cut the marker post from 4-inch by 4-inch dense structural grade Douglas fir No. 2 or Southern Pine No. 2 surfaced on four sides to a length of 5 feet. Chamfer the top. Set the post in concrete, 2 feet into the ground, away from traffic, and to the side of the pipeline. Coat with a seal and finish coat of white alkyd exterior paint. On the side facing the

valve, letter in black the word "VALVE" and the distance in feet from the marker post to the valve box cap.

E. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior or the extension pipe.

3.06 FIELD COATING BURIED VALVES

A. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 099000, System No. 30.

B. Wrap buried metal valves 6 inches and larger with polyethylene sheet in two layers of polyethylene conforming to AWWA C105, 8 mils in thickness each. Pass the two sheets of polyethylene under the valve and the coated flanges or joints with the connecting pipe and draw the sheets around the valve body, the valve bonnet, and the connecting pipe. Secure the sheets with plastic adhesive tape about the valve stem below the operating nut and about the barrel of the connecting pipe to prevent the entrance of soil. Fold overlaps twice and tape. Backfill the valve with care to avoid damaging the polyethylene.

3.07 ASSEMBLING JOINTS

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

D. Install grooved-end couplings for valves in accordance with Section 40 05 00.

3.08 INSTALLING EXTENSION STEM GUIDE BRACKETS

Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

3.09 MOUNTING GEAR ACTUATORS

The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

3.010 FIELD INSTALLATION OF GEAR ACTUATOR

Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

3.011 VALVE FIELD TESTING

A. Test valves for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 40 05 15 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

C. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

SECTION 40 05 80

FABRICATED STAINLESS STEEL SLIDE GATES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of fabricated stainless steel slide and weir gates, open channel or wall mounted conforming to AWWA C561 and as supplemented herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 09 90 00.

B. Equipment, Piping, Duct, and Valve Identification: 400775.

C. Electric Motor Actuators for Valves and Slide Gates: 409210.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Requirements Section 01 33 00.

B. Submit dimensional drawings.

C. Submit manufacturer’s catalog data and detail drawings showing slide gate parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show coatings.

D. Submit calculations to show that gates, stems, and lifts meet the specifications.

E. Submit manufacturer's installation instructions.

1.04 MANUFACTURER'S SERVICES

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

A. One labor day to check the installation and advise during start-up, testing, and adjustment of the equipment.

B. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

PART 2 - MATERIALS

2.01 MANUFACTURERS AND MODELS

A. Type 3 slide gates shall be of the self-contained upward-opening type with guides for embedding in concrete. Type 3 slide gates shall be Rodney Hunt Series A, Whipps Series 900, Fontaine Aquanox Series 20, or equal.

B. Type 4 slide gates shall be of the self-contained upward opening type designed to mount on the face of concrete walls. Type 4 slide gates shall be Rodney Hunt Series **A,** Whipps Series 900, Fontaine Aquanox Series 20, or equal.

2.02 SLIDE GATE DESIGN

A. Slide gates and appurtenances shall comply with AWWA C561, except as modified herein.

B. Provide slide gates complete with gates, guides, frames, baseplates, seats, stems, stem guides, seals, actuators, and anchor bolts. Design slide gates for minimum seating and unseating heads of 10 feet. Measure the seating and unseating heads from the top surface of the water to the centerline of the disc.

C. Under the design seating and unseating heads, the leakage shall not exceed 0.1 gpm per foot of wetted seating perimeter.

D. Slide gates shall have rising stems.

2.03 FRAMES FOR SELF-CONTAINED SLIDE GATES

A. Design frames to be suitable for bolting to concrete walls or for grouting into channel recesses as noted herein. Furnish flush inverts for wall-mounted gates and flush inverts for channel-mounted gates as noted herein.

2.04 GUIDES

A. Guides shall incorporate a two-slot design. One slot shall accept the disc plate. The second slot shall accept the reinforcing ribs of the disc. The guides shall extend in one continuous piece from the gate invert to form posts for handwheel operator stand. The extended guides or posts shall require no additional reinforcing to support the operator. Construct the guides of formed plate into a rigid, continuous structural shape.

B. Provide a flush invert at the bottom of the frame. Provide a rubber insert to function as a seating surface for the gate disc.

C. Provide rubber J-bulb or UHMW polyurethane seals or seats along the sides of the gates.

D. For self-contained gates, provide replaceable polyethylene bearing strips in extruded retainer slots along the guides. Provide strips along both sides of the guide channels containing the disc. Mount strips in dovetail grooves in the guides. Alternatively, mount the replaceable polyethylene bearing strips on the disc.

E. Provide rubber or UHMWPE J-bulb seals along the top of the gate for submerged applications.

2.05 DISC

A. Fabricate the disc using stainless steel flat plate with stainless steel structural or formed members welded to the plate. Provide disc components with a minimum material thickness of 1/4 inch.

B. The disc shall be a one-piece plate, reinforced with ribs so that the disc will not deflect more than 1/720 the gate span when the upstream side of the gate is subjected to the specified seating head and the downstream side of the gate contains no liquid. Design the disc to limit deflection to a maximum of 1/8 inch when the disc is subjected to the maximum specified unseating head. Attach reinforcing ribs to disc by welding; do not use bolting. Reinforcing ribs shall extend into the guides such that they overlap the seating surface of the guide. Design the disc so that all surfaces are free of metal-to-metal contact with the frames.

2.06 ACTUATOR SUPPORT YOKE FOR SELF-CONTAINED SLIDE GATES

Attach the actuator support yoke to the extensions of the guides. Provide two angles or structural channels bolted to opposite sides of the guide extensions. Mount the actuator on a plate bolted to the support yoke. Maximum deflection of the yoke shall not exceed 1/4 inch when subjected to a load induced by an 80-pound pull on the actuator or 1/360 span when subjected to a load induced by a 40-pound pull on the actuator, whichever is less.

2.07 STEMS AND STEM GUIDES

A. Lifting stems shall be one piece, with a minimum diameter of 1 1/2 inches. The stem shall withstand an actuator effort of 80 pounds without buckling, assuming the critical buckling load as determined by using the Euler Column Formula with C = 2.0. Support the stems with stem guides such that the L/R ratio for the unsupported part of the stem does not exceed 200.

B. The stem connection to the disc shall be either the clevis type, with structural members welded to the slide and containing a bolt to act as a pivot pin, or a threaded and bolted or keyed thrust nut supported in a welded nut pocket. The pocket shall be capable of withstanding a load of 80 pounds on the actuator.

C. Provide tandem stems and actuators when the gate width is more than twice the gate height.

2.08 MATERIALS OF CONSTRUCTION

Materials of construction shall conform to the requirements listed below:

Component	Material	Specification
Guides	Stainless steel	ASTM A240 or A276, Type 316
Disc, yoke	Stainless steel	ATSM A240 or A276, Type 316
Stems, stem guides, bushings, pivot pin	Stainless steel	ASTM A276, Type 304 or 303
Bolts, fasteners (including anchor bolts)	Stainless steel	ASTM A193, F593 or F594; Grade B8M
Lift nut	Bronze	ASTM B62 or ASTM B584, Alloys C83600, C83800, or C86500
J-bulb seals, flush bottom seals	Rubber or UHMW polyurethane	ASTM D2000, Grades BC610, BC611, BC612, BC613, BC614, or BC615 or ASTM D4020

2.09 ACTUATORS

A. Provide manual actuators unless otherwise indicated in the drawings. Provide Acme threaded handwheel lifts without gear reduction for gates having design seating heads 10 feet or less. Provide a flanged lift nut to engage the threaded portion of the stem. Support the lift nut on nonmetallic thrust washers or ball or roller bearings. Provide manual crank-operated lift with gear reduction for gates having design seating heads greater than 10 feet. Maximum pull required to open the gate shall not exceed 40 pounds. Support crank-operated lift nuts only on ball or roller bearings. The crank handle shall be removable. Provide a 2-inch-square nut configured to allow the use of a portable electric actuator.

B. Provide motor actuators where shown in the drawings, as specified in Section 409210.

C. Provide a graduated clear plastic stem cover to show the gate position in increments of 1/4 inch. Provide vent holes to prevent condensation.

2.10 FLOOR STANDS

A. Design crank-operated or handwheel-operated floor stand hoists to permit gate operation with 40 pounds of maximum effort under the head conditions noted in the drawings.

B. Provide floor stand hoists that can also accommodate a portable electric actuator.

2.11 SPARE PARTS

A. Provide the following spare parts for each size of slide or weir gate:

Quantity	Description
2	Lift nuts
4	Stem guides of each type and size
2	Pivot pins
1 set	Sealing strips

B. Pack spare parts in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained within.

PART 3 - EXECUTION

3.01 WELDING

Welder qualification shall comply with AWS D1.6 Welding rod and electrodes shall comply with AWS A5.4. In addition to structural welds, seal weld interfaces between mating parts to prevent moisture intrusion.

3.02 PAINTING AND COATING

Coat cast-iron and steel surfaces above deck level, including actuators and floor stands, per Section 099000.

3.03 INSTALLATION

A. Cast the anchor bolts for wall-mounted gates into the wall using templates.

B. Comply with AWWA C561, paragraph 4.6.

3.04 FIELD TESTING

A. Operate each slide gate through two complete cycles. Gates shall operate without sticking or binding.

B. Determine the pulling force required to turn the handwheel with a torque wrench. Pulling force required shall be less than the limit specified.

C. Fill channels to which the gates are attached with water. Measure leakage through each slide gate. Measure the actual field seating and unseating heads. The allowable leakage shall be as specified above. If the leakage rate is exceeded, adjust or replace the gate and retest until it passes.

END OF SECTION

SECTION 40 07 22

FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials and installation of flexible gasketed sleeve-type compression pipe couplings for steel and ductile-iron pipe; expansion joints 4 inches in diameter and smaller for steel, PVC, pipe; flexible expansion joints; and couplings for connecting different pipe materials.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data on flexible pipe couplings, and expansion joints. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.

C. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.

D. Show materials of construction by ASTM reference and grade. Show dimensions.

E. Show number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

PART 2 MATERIALS

2.01 COUPLING SYSTEM DESIGN AND COMPONENT UNIT RESPONSIBILITY

The coupling manufacturer shall furnish the gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types and shall design these components as an integral system. Design the gaskets for the coupling and appropriately size to provide a watertight seal at the design pressure and temperature. Ship gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings with the pipe coupling and clearly label indicating the origin of the material, including place and date of manufacture. Package the manufacturer's printed installation instructions with each pipe coupling.

2.02 CARBON STEEL FLEXIBLE PIPE COUPLINGS AND FLANGED COUPLING ADAPTERS

A. Steel couplings shall have center sleeves and end rings made of carbon steel conforming to AWWA C219, Section 4. Minimum center sleeve length shall be 5 inches for pipe sizes 3/4 inch through 4 1/2 inches, 7 inches for pipe sizes 5 inches through 24 inches, and 10 inches for pipe sizes larger than 24 inches.

B. Sleeve bolts in exposed service shall be carbon steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.

C. End rings shall be cast, forged, or hot rolled in one piece. Do not use rings fabricated from two or more shapes.

D. Wall thickness of sleeve shall be at least that specified for the size of pipe in which the coupling is to be used.

2.03 STAINLESS STEEL FLEXIBLE PIPE COUPLINGS AND FLANGED COUPLING ADAPTERS

A. Stainless steel couplings shall have center sleeves and end rings made of Type 316 stainless steel conforming to AWWA C219, Section 4. Minimum center sleeve length shall be 5 inches for pipe sizes 3/4 inch through 4 1/2 inches, 7 inches for pipe sizes 5 inches through 24 inches, and 10 inches for pipe sizes larger than 24 inches.

B. Sleeve bolts shall be Type 316 stainless steel per AWWA C219, Section 4.

C. End rings shall be cast, forged, or hot rolled in one piece. Do not use rings fabricated from two or more shapes.

D. Wall thickness of sleeve shall be at least that specified for the size of pipe in which the coupling is to be used.

2.04 DUCTILE-IRON FLEXIBLE PIPE COUPLINGS

A. Couplings shall have center sleeves and end rings made of ductile iron conforming to AWWA C219, Section 4.

B. Sleeve bolts in exposed service shall be carbon steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.

2.05 JOINT HARNESSES

A. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H. Lug material shall conform to ASTM A36, ASTM A283, Grade B, C, or D, or ASTM A285, Grade C. Lug dimensions for steel pipe shall be as shown in AWWA Manual M11 (2004 edition), Figure 13-20, using the number and size of lugs as tabulated below.

B. Lugs for steel pipe shall be Type P for pipes 6 through 10 inches and Type RR for pipes 12 inches and larger. Lug or ear dimensions for ductile-iron pipe shall be as shown in the drawings.

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR STEEL PIPE				
Nominal Pipe Size (inches)	Tie Bolt or Stud Minimum Requirements			
	150 psi		300 psi	
	No. Bolts or Studs and Size (inches)	Minimum Pipe Wall Thickness (inches)	No. Bolts or Studs and Size (inches)	Minimum Pipe Wall Thickness (inches)
6	2 x 5/8	0.193	2 x 5/8	0.282
8	2 x 5/8	0.239	2 x 5/8	0.354
10	2 x 5/8	0.312	2 x 3/4	0.466
12	2 x 3/4	0.188	4 x 7/8	0.250
14	2 x 7/8	0.188	4 x 1	0.250
16	2 x 1	0.250	4 x 1 1/8	0.250
18	2 x 1 1/8	0.250	4 x 1 1/8	0.250
20	2 x 1 1/4	0.250	4 x 1 1/8	0.250
24	4 x 7/8	0.250	4 x 1 1/8	0.250
30	4 x 1 1/8	0.250	4 x 1 3/8	0.375
36	4 x 1 3/8	0.313	6 x 1 3/8	0.375
42	6 x 1 1/4	0.375	6 x 1 5/8	0.375
48	6 x 1 3/8	0.375	6 x 1 3/4	0.500
54	6 x 1 1/2	0.375	8 x 1 3/4	0.625
60	6 x 1 5/8	0.375	12 x 1 3/4	0.625
66	8 x 1 5/8	0.469	14 x 1 3/4	0.688
72	8 x 1 3/4	0.500	14 x 1 7/8	0.750

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR DUCTILE IRON PIPE						
	Tie Bolt or Stud Minimum Requirements					
	150 psi(1)			300 psi(2) Pipe		
Nominal Pipe Size (inches)	No. Bolts or Studs	Size (inch)	Ear(3) Type	No. Bolts or Studs	Size (inch)	Ear(3) Type
4	2	5/8	A	2	5/8	A
6	2	5/8	A	2	5/8	A
8	2	5/8	A	2	5/8	A
10	2	5/8	A	4	5/8	A
12	2	5/8	A	4	5/8	A
14	4	5/8	A	5	3/4	A
16	4	5/8	A	5	3/4	B
18	4	3/4	B	8	3/4	B
20	4	3/4	B	8	3/4	B
24	5	7/8	B	8	7/8	B
30	4	1 1/8	B	14	7/8	B
36	8	1	B	16	1	B
42	9	1	B	--	--	--
48	14	1	B	--	--	--
54	16	1	B	--	--	--

(1) Use ASME B16.1 Class 125 flanges.

(2) Use ASME B16.1 Class 250 flanges.

(3) Ear type as shown in the detail on the last page of Section 400722.

C. Select number and size of bolts based on the test pressure shown in the Piping Schedule in the drawings. Stagger bolts equally around pipe circumference. Where odd number is tabulated, place odd bolt at top. For test pressures less than or equal to 150 psi, use the 150-psi design in the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.

D. Provide washer for each nut. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8 inch.

2.06 FLEXIBLE PIPE COUPLINGS FOR PLAIN-END DUCTILE-IRON PIPE

A. Couplings for pipe 12 inches and smaller shall be cast iron, Dresser Style 253 or 253 long sleeve, Smith-Blair Type 441, Baker Series 228, or equal.

B. Couplings for pipe larger than 12 inches shall be cast iron or steel, Dresser Style 38 or 253, Smith-Blair Style 411, Baker Series 228, or equal.

2.07 TRANSITION COUPLINGS

Couplings for connecting different pipes having different outside diameters shall be 316 stainless steel: Dresser Style 62 or 162, Smith-Blair Series 413, Baker Series 212 or 220, or equal. Couplings shall have an internal full circumference ring pipe stop at the midpoint of the coupling. Inside diameter of coupling pipe stop shall equal inside diameter of smaller diameter pipe.

2.08 FLANGED COUPLING ADAPTERS FOR CAST- AND DUCTILE-IRON PIPE

A. Adapters for cast- and ductile-iron pipe 12 inches and smaller shall be cast iron: Dresser Style 127, Smith-Blair Series 912, or equal.

B. Adapters for cast- and ductile-iron pipe larger than 12 inches shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal.

C. Flange ends shall match the flange of the connecting pipe; see detail piping specifications.

2.09 SEGMENTED RESTRAINED SLEEVE COUPLINGS AND FLANGED ADAPTER COUPLINGS FOR CARBON AND STAINLESS STEEL PIPE

A. The coupling shall be of the split or segmented sleeve type with a double arch cross-section, which closes around plain steel pipe ends, and complying with AWWA C227 except as modified herein. The design pressure and wall thickness of the body shall be

at least that specified for the size of pipe on which the coupling is to be used. Provide welded steel restraint rings on the pipe ends for end restraint. As the coupling closes, it shall confine an elastomeric gasket on each pipe end to create a radial seal. The axial seal shall be affected at the closure plates as bolts pull the coupling snug round the pipe. Provide shoulders on each end of the couplings. Flanged adapter couplings shall incorporate a flange on one end (instead of an end ring and shoulder) to match the flange on the connecting pipe or valve. Products: Victaulic “Depend-O-Lok” Model F x F Type 2 for sleeve couplings or Victaulic “Depend-O-Lok” Model F x F flanged adapter coupling for flanged adapter couplings.

B. Carbon steel piping includes steel pipe lined with polyurethane, or epoxy.

C. Body, flange, and closure plates for couplings used with carbon steel pipe in exposed service shall be carbon steel per ASTM A36.

D. End restraint rings for couplings used with carbon steel pipe shall be carbon steel per ASTM A108, Grade 1020. Provide end restraint rings on each of the connecting pipes. The end rings shall be welded to the pipe ends using a welding procedure complying with the ASME Pressure Vessel Code, Section IX. Weld the end restraint rings to the pipe before applying the lining and coating (if any is specified) to the pipe. The welded end restraint rings shall have at least the pressure rating of the pipe to which the coupling is attached.

E. Fasteners for couplings used with carbon steel pipe in exposed service shall be carbon steel per ASTM A325, with carbon steel nuts and washers per ASTM A563.

F. Coupling body, flange, and closure plates for couplings used with stainless steel pipe shall be Type 316 or 316L stainless steel per ASTM A240 or A666.

G. End restraint rings for couplings used with stainless steel pipe shall be Type 316 or 316L stainless steel per ASTM A276. Provide end restraint rings on each of the connecting pipes. Weld the end rings to the pipe ends using a welding procedure complying with the ASME Pressure Vessel Code, Section IX. The welded end restraint rings shall have at least the pressure rating of the pipe to which the coupling is attached.

H. Fasteners for couplings used with stainless steel pipe shall be Type 316 stainless steel per ASTM A276, F593, or F738 with stainless steel nuts per ASTM F594 or F836.

I. Gaskets shall be isoprene, Buna-N, or EPDM conforming to ASTM D2000 for water and sewage service and having a temperature range of -20°F to +180°F.

J. Provide joint sealant between the pipe ends for piping 24 inches and larger after the sleeve coupling is installed: Sikaflex 2C with Sikaflex 429 primer.

PART 3 - EXECUTION

3.01 SHIPMENT AND STORAGE OF FLEXIBLE PIPE COUPLINGS, DISMANTLING JOINTS, AND EXPANSION JOINTS

A. Inspect on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload carefully to the ground without dropping. Do not load or unload by inserting forklift tines or lifting chains inside the waterway. Use nonmetallic slings, padded chains, or padded forklift tines to lift items. Lift with eyebolts or rods through flange holes or chain hooks at ends.

B. Protect from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer’s specific storage instructions.

C. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean.

D. Do not allow stainless steel couplings or other items to contact carbon steel surfaces during storage, handling, or installation and erection at the site.

3.02 INSTALLATION OF FLEXIBLE PIPE COUPLINGS, SEGMENTED SLEEVE COUPLINGS, DISMANTLING JOINTS, AND EXPANSION JOINTS

A. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installing.

B. Install expansion joints per manufacturer's recommendations, so that 50% of total travel is available for expansion and 50% is available for contraction.

C. Do not spring flanges or ends of connecting piping into position. Separately work connecting piping system into position to bring the piping flanges or ends into alignment with the matching coupling flanges or joints. Do not move couplings to achieve piping alignment.

D. Line up pipe flange bolt holes with coupling or joint flange bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

E. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

F. Lubricate bolt threads with graphite and oil prior to installation.

G. Thoroughly clean contact surfaces of gaskets and pipe ends of flexible pipe couplings just prior to assembly for a distance equal to center-sleeve length plus 2 inches. Install flexible pipe couplings such that the center sleeves are centered over the gap between the ends of the pipes being joined. Install centerline gaps per AWWA C219, Table 5 unless otherwise indicated. Install harnessed flexible pipe couplings in straight-run piping such that 50% of the total travel of the center sleeve or permissible centerline gap is available for expansion and 50% of the travel is available for contraction. In assembling the bolted or studded harnesses of flexible pipe couplings, tighten the nuts gradually and equally at diametrically opposite sides until snug. Do not misalign the harness bolts or studs. Tighten such that bolts or studs carry equal loads. Do not use wrenches or power fastening tools to tighten the nuts.

H. Install segmented sleeve couplings per AWWA C227, Section 4.6.

3.03 PAINTING AND COATING

A. Coat buried flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters per Section Coat buried bolt threads, tie bolt threads, and nuts per Section 09 90 00, System No. 30. Then wrap the couplings with polyethylene wrap.

B. Coat flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. If the adjacent pipe is not coated, coat couplings per Section 09 90 00. Apply prime coat at factory.

C. Line carbon steel and iron flexible pipe couplings and segmented sleeve couplings per Section 09 90 00.

D. Alternatively, line and coat carbon steel and iron flexible pipe couplings with fusion-bonded epoxy.

E. Coat, expansion joints,, and alignment guides located above ground or in vaults and structures with the same coating system as specified for the adjacent pipe. If the adjacent pipe is not coated, coat couplings per Section 09 90 00. Color shall match the color of the connecting pipe.

3.04 HYDROSTATIC TESTING

Hydrostatically test flexible pipe couplings, and expansion joints, in place with the pipe being tested. Test in accordance with Section 40 05 15.

END OF SECTION

SECTION 40 07 62

WALL PIPES, SEEP RINGS, AND PENETRATIONS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of steel, cast-iron, and ductile-iron wall pipes and sleeves (including wall collars and seepage rings) and penetrations.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit detail drawings for fabricated steel or cast-iron wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.

C. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.

D. Show grooved-end dimensions and AWWA grooved-end dimensional standard where grooved-end wall pipes or penetrations are used.

E. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.

F. List materials of construction, with ASTM material reference and grade.

G. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.

H. Submit six copies of the results of the leakage test for cast-iron sleeves having shrink-fit steel collars or collar halves bottomed in a groove and steel sleeves having welded steel collars.

PART 2 MATERIALS

2.01 GENERAL

A. Use cast-iron, ductile-iron, or fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes.

B. Use only cast-iron or ductile-iron wall pipes when connecting to cast-iron and ductile-iron pipe. Use only fabricated steel or stainless steel wall pipes when connecting to steel or stainless steel pipe, respectively.

C. Cast-iron flanges shall conform to ASME B16.1, Class 125 or 250, to match the flange on the connecting pipe.

D. Class 150 steel flanges shall conform to AWWA C207, Class D. Flanges shall be flat face. Flanges shall match the flange on the connecting pipe.

E. See Section 40 05 00 for flange bolts and gaskets.

2.02 CAST-IRON OR DUCTILE-IRON WALL PIPES AND SLEEVES

A. Provide cast- or ductile-iron wall pipes with ends as shown in the drawings for connection to adjacent cast-iron and ductile-iron pipe or for containing pipes where they pass through concrete walls, ceilings, and floor slabs. Provide seepage ring on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Locate collars such that the collar is at the center of the wall or floor slab, unless otherwise shown in the drawings.

B. Wall pipes and sleeves shall be of the following types:

1. Pipe or sleeve with integrally cast seep ring.

2. Pipe or sleeve with shrink-fit steel collar attached.

3. Pipe or sleeve with steel collar halves bottomed in a groove provided in the pipe or sleeve.

C. Minimum wall thickness for pipes and sleeves having integrally cast seep rings shall be as shown in the following table:

Pipe or Sleeve Size (inches)	Minimum Wall Thickness (inches)
3	0.48
4	0.52
6	0.55
8	0.60
10	0.68
12	0.75
14	0.66
16	0.70
18	0.75
20	0.80
24	0.89

D. Minimum wall thickness of pipes or sleeves having shrink-fit collars shall be special Class 52. Cut shrink-fit collars from a 1/4-inch-thick steel ring. Attach the collar to a cast-iron or ductile-iron pipe or sleeve by heating the steel collar and allowing it to shrink over the pipe at the necessary location. Provide an epoxy bond (Keysite 740 or 742 or Scotchkote 302) between the pipe and collar. Sandblast the area of the pipe to be epoxy coated per SSPC SP-10.

E. Wall pipes or sleeves having steel collar halves bottomed in a groove shall be ductile iron Special Class 54 minimum unless otherwise shown. Wall flanges shall consist of 1/4-inch-thick steel seep ring halves for pipes through 24-inch and 3/8-inch-thick halves for pipe 30 inches and larger, bottomed in a groove provided on the pipe. The pipe groove shall be machine cut to a depth of 1/16 to 5/64 inch to provide a press fit for the seep ring. Seep ring halves shall be welded together after fit into groove but shall not be welded to pipe. Seep rings shall be sealed completely around the pipe with silicon sealant manufactured by Dow-Corning No. 790, General Electric Silpruf, or equal.

F. The material used in cast- or ductile-iron wall flanges, wall sleeves, and wall penetrations shall conform to ASTM A395, A436, A536, A48 (Class 35), or A126 (Class B).

2.03 FABRICATED STEEL WALL PIPES AND SLEEVES

A. Provide fabricated steel wall pipes and sleeves with ends as shown in the drawings for connection to adjacent steel pipes, or for containing pipes, where they pass through concrete walls. Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe. Minimum wall thickness for sleeves containing pipes shall be standard weight per ASME B36.10 for sleeves 72 inches and smaller and 1/2 inch for sleeves greater than 72 inches through 96 inches.

B. Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from a 1/4-inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16-inch fillet welds. Welding procedures shall be in accordance with ASME B31.3, Chapter V.

C. Steel pipe used in fabricating wall sleeves containing pipes shall comply with ASTM A53 (Type E or S), Grade B; ASTM A135, Grade B; ASTM A139, Grade B; or API 5L or 5LX. Wall pipes connecting to steel pipe shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A36, A105, A181, or A182.

D. Stainless steel pipe used in fabricating wall pipes shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A240.

2.04 RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

A. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.

B. Materials of construction shall be as follows:

Compound	Material
Pressure plate	Delrin plastic or reinforced nylon polymer
Bolts and nuts for links	316 stainless steel
Sealing element	EPDM rubber

C. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.

D. Provide centering blocks in 25% of the sealing elements on pipelines larger than 12 inches in diameter.

E. The rubber annular hydrostatic sealing devices shall be Link Seal as manufactured by Thunderline Corporation; Innerlynx as manufactured by Advance Products & Systems, Inc.; or equal.

2.05 BOLTS, NUTS, AND GASKETS FOR FLANGED-END WALL PIPES

See Section 40 05 00.

2.06 POLYETHYLENE FOAM FILLER FOR PIPE PENETRATIONS

Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/2 inch larger in diameter than the annular space.

2.07 POLYURETHANE SEALANT FOR PIPE PENETRATIONS

Sealant shall be multipart, polyurethane sealant, to cure at ambient temperature, for continuous immersion in water. Install as recommended by the manufacturer. Products: SIKA Sikaflex 2C or equal.

2.08 PAINTING AND COATING

A. Line and coat sleeves and pipes (except stainless steel) with fusion-bonded epoxy per Section 09 97 61.

B. Coat penetrations and sleeves exposed, above ground, or in vaults and structures in accordance with Section 09 90 00 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

C. Coat submerged sleeves and penetrations per Section 09 90 00 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

D. Coat buried sleeves and penetrations per Section 09 90 00 unless fusion-bonded epoxy per Section 09 97 61 is shown in the drawings or specified elsewhere.

E. Do not coat stainless steel sleeves and penetrations.

PART 3 EXECUTION

3.01 LOCATION OF PIPES AND SLEEVES

A. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.

B. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless steel pipe 3 inches and smaller or stainless steel or copper tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.

C. Provide wall sleeves where shown in the drawings and wherever plastic, steel or stainless steel pipe 3 inches and smaller, or stainless steel or copper tubing passes through a wall. Provide a single rubber annular seal when the wall is 8 inches thick or less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8 inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

D. Where wall sleeves are installed in which water or soil is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).

E. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

3.02 INSTALLATION IN EXISTING CONCRETE WALLS AND SLABS

Core drill holes 1 to 2 inches larger in diameter than the outside diameter of the wall flange or collar. Install wall pipe and collar assembly axially aligned with the piping to which it will be connected or will contain. Pack the void space between the sleeve and

concrete with grout. See Section 033000 for grouting specification, or polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure where shown on the drawings.

3.03 INSTALLATION IN NEW CONCRETE WALLS AND SLABS

Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

3.04 INSTALLATION IN DRY FLOORS AND SLABS

Install pipe sleeves and spools in concrete floors and slabs which do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2 inches above the floor or slab unless shown otherwise in the drawings.

3.05 INSTALLATION OF WALL PIPES HAVING FLANGED END CONNECTIONS

A. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.

B. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

3.06 QUALIFICATIONS OF WELDERS

Welder qualifications shall be in accordance with AWS D1.1.

3.07 INSTALLATION OF RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

Install in accordance with the manufacturer's instructions.

3.08 FIELD TESTING

Check each wall penetration for leakage at the time the hydraulic structure is tested for leakage; see Section 03 30 00. Penetrations shall show zero leakage.

END OF SECTION

SECTION 40 07 64

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws, neoprene isolation pads.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.

C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

D. Submit layout drawings for the drip guards, showing dimensions and thicknesses. Show design of seam or joint where field connections will be made between sections and pieces of drip guards. Submit a certificate listing the type of resin to be used, describing the manufacturer's brand name or designation, composition, and characteristics.

PART 2 MATERIALS

2.01 DESIGN CRITERIA

A. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.

B. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.

2.02 HANGER AND SUPPORT SYSTEMS

A. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.

B. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced in the drawings. Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable steel clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102
3	Steel double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	Steel pipe clamp (pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
4	Steel pipe clamp (pipes 3 inches and larger)	Anvil Fig. 216, B-Line 3142
5	Pipe hanger	B-Line B3690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable steel band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B3373
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF

Type Number	Description	Manufacturer and Model (or Equal)
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	Steel turnbuckle	Anvil Fig. 230, B-Line B3202
14	Steel clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	Malleable iron socket	Anvil Fig. 110R, B-Line B3222
17	Steel weldless eye nut	B-Line B3200
18	Steel or malleable iron concrete insert	Anvil Fig. 281, Superstrut 452
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134
22	Welded attachment type	Anvil Fig. 66 B-Line B3083
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	Steel I-beam clamp with eye nut	Anvil Fig. 228
29	Steel wide flange	Anvil Fig. 228 clamp with eye nut
30	Malleable iron beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066

Type Number	Description	Manufacturer and Model (or Equal)
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B-Line B3114
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B-Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B-Line B3117SL

C. Pipe hangers and supports shall be carbon steel (ASTM A36, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A47).

2.03 OFFSET PIPE CLAMP

Anvil Figure 103 or equal. Material shall be Type 316 stainless steel.

2.04 MISCELLANEOUS PIPE SUPPORTS AND HANGERS

A. Pipe Anchor Chair: Anvil Figure 198 or equal.

B. One Hole Clamp: Anvil Figure 126 or equal.

C. Roller Chair: Anvil Figure 175 or equal.

2.05 STEEL CHANNEL FRAMING SYSTEM

A. Steel channel frames shall be 1 5/8 inches wide by 1 5/8 or 3 1/4 inches high by 12-gauge metal thickness, unless otherwise shown in the drawings. Material shall conform to ASTM A36, A570 (Grade 33 minimum), or A653 unless stainless steel is indicated in the drawings. Stainless steel shall be Type 304. One side of the channel shall have a continuous open slot with inturned clamping ridges. Maximum allowable stress under any combination of applied uniformly distributed loads and concentrated loads shall not exceed those recommended in the AISC or AISI. Deflection shall not exceed 1/240 of span. Use multiple back-to-back channels to achieve these criteria if single channels are not sufficient. Products: Unistrut P1000 or P5000 Series, B-Line B11 or B22 Series, or equal.

B. Steel channels shall be hot-dipped galvanized per ASTM A153.

C. Nuts shall be machined and case hardened. Provide rectangular nuts with the ends shaped to permit a quarter turn crosswise in the framing channel. Provide two serrated grooves in the nut to engage the inturned edges of the channel.

D. Pipe clamps (including attachment screws and nuts) shall be Unistrut P1100 or P2000 Series, B-Line B2000 Series, or equal. Material shall be Type 316 stainless steel.

E. Hanger rods for trapezes shall be carbon steel (ASTM A36, A575, or A576) unless stainless steel is indicated in the drawings. Stainless steel hanger rod material shall comply with ASTM A276, Type 304.

F. Accessory fittings and brackets shall be the same material as the channel or trapeze. Provide coating on carbon steel fittings and brackets as specified for the channels and frames.

   a. Flat Plate Fittings: Unistrut P1065, P1066, P1925; Superstrut AB-206, AB-207; or equal.

   b. Post Bases: Unistrut P2072A, Superstrut AP-232, or equal.

   c. 90-Degree Brackets: Unistrut P1326, P1346; Superstrut AB-203; or equal.

   d. Rounded-End Flat Plate Fittings: Unistrut P2325, Superstrut X-240, or equal.

G. Parallel pipe clamps shall be Unistrut P1563 through P1573, Superstrut AB-719, or equal. Material shall be Type 304 stainless steel.

2.06 FRP CHANNEL FRAMING SYSTEM

A. FRP pipe hangers and supports shall be Aickinstrut, Inc., or equal.

B. Material properties shall be as follows:

	Longitudinal Direction
Ultimate Tensile (psi)	35,000 minimum
Ultimate Compressive (psi)	35,000 minimum
Ultimate Flexural (psi)	35,000 minimum
Tensile Modulus (psi)	3.0×10^6 minimum
Flexural Modulus (psi)	2.0×10^6 minimum
Ultimate Shear Strength (psi)	6,000 minimum
Izod Impact (ASTM D256) ft-lb/inch notch	30 minimum
	Transverse Direction
Ultimate Tensile (psi)	10,000 minimum
Ultimate Compressive (psi)	20,000 minimum
Ultimate Flexural (psi)	14,000 minimum
Tensile Modulus (psi)	1.0×10^6 minimum
Compressive Modulus (psi)	1.4×10^6 minimum
Flexural Modulus (psi)	1.0×10^6 minimum
Ultimate Shear Strength (psi)	5,500 minimum
Ultimate Bearing Stress (psi)	35,000 minimum
Izod Impact, ft-lb notch	5 minimum
	Hardness
Barcol Test	50 minimum

C. Glass fiber reinforced composites and plastic products shall have a flame spread rating of 25 or less when tested per ASTM E84.

D. Channel framing shall be 1 5/8 inches deep by 1 5/8 inches wide and shall be made using vinylester resin equal to Ashland Derakane 411, Ashland Hetron 922, or Reichhold Dion 9800. It shall have a nexus polyester surfacing veil over 100% of the surface which, along with a filler system, will protect against degradation from ultraviolet light. Channel shall be supplied with integral notches 1 inch on center. Notches shall be located on the interior flange to prevent slippage of pipe clamps and fittings after installation. In place of notched channel, unnotched channel may be used if the vertical channel sections supporting the horizontal piping are provided with stop lock hardware at each pipe clamp to prevent slippage. Channel framing shall be Aickinstrut G.R.P. Type V 2000 series or equal.

E. Channel framing connections shall be made with vinylester glass fiber composite nuts, bolts, all threaded rods, channel fittings, bases, and hanger assemblies. Nuts, bolts, and rods shall be Aickinstrut 4200 series, Strut Tech PVCG, or equal. Channel fittings shall be Aickinstrut 2800 style or equal.

F. Load-bearing pipe clamps and nonload-bearing pipe straps shall be nonmetallic and nonconductive and shall be made by the injection molding process using polyurethane base resin. Pipe clamps and straps shall be Aickinstrut 3100 series or equal.

G. Clevis hangers shall be made with vinylester glass fiber and be Aickinstrut 1500 series or equal.

H. Hanger rods for trapezes shall be carbon steel (ASTM A36, A575, or A576) unless stainless steel is indicated in the drawings. Stainless steel hanger rod material shall comply with ASTM A276, Type 304.

2.07 NEOPRENE ISOLATING SLEEVES FOR METAL PIPE 6 INCHES AND SMALLER

Unistrut P2600, B-Line "Vibrocushion," or equal.

2.08 ANCHOR BOLTS AND SCREWS

Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be Type 316 stainless steel, ASTM A276 or F593. Nuts

shall be Type 316 stainless steel, ASTM A194, Grade 8M or ASTM F594, Type 316 stainless steel.

PART 3 EXECUTION

3.01 PIPE HANGER AND WALL SUPPORT SPACING

Install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed in the drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes shown or detailed in the drawings. If no spacing or rod sizes are given in the drawings or in the specifications for a particular piping system, use the following:

A. Pipe Hanger and Wall Support Spacing for Ductile-Iron, Stainless Steel (Sections 40 20 40, 40 20 76):

Pipe Size (inches)	Maximum Support or Hanger Spacing (feet)	Minimum Rod Size (inches)
3/8 and smaller	4	3/8
1/2 through 1	6	3/8
1 1/4 through 2	8	3/8
2 1/2 and 3	10	1/2
3 1/2 and 4	10	5/8
6	12	3/4
8	12	7/8
10 and 12	14	7/8
14 and 16	16	1
18	15	1
20 through 24	9	1
30	6	1

B. Pipe Hanger or Wall Support Spacing for PVC Pipes (Section 402090):

Pipe Size (inches)	Maximum Support or Hanger Spacing (feet)	Minimum Rod Size (inches)
3/4	4	3/8
1	4	3/8
1 1/2	5	3/8
2	5	3/8
2 1/2	5	1/2
3	6	1/2
4	6	5/8
6	7	3/4
8	7	7/8

C. Pipe Hanger or Wall Support Spacing for Copper Tubing and Pipe (Section 402022):

Pipe Size (inches)	Maximum Support or Hanger Spacing (feet)	Minimum Rod Size (feet)
1 and smaller	4	3/8
1 1/4 through 2	6	3/8
2 1/2 through 3	8	1/2

D. Pipe Hanger or Wall Support Spacing for Polypropylene Pipe (Sections 402455):

Pipe Size (inches)	Maximum Hanger or Support Spacing (feet)	Minimum Rod Size (inches)
1	3	3/8
1 1/2	4	3/8
2	5	3/8
3	6	1/2
4	6	5/8
6	7	3/4
8	8	7/8
10	9	7/8
12	10	7/8
14 to 16	10	1
18	10	1
20 to 24	9	1
30	6	1

E. Pipe Hanger or Wall Support Spacing for Stainless Steel Tubing (Sections 402078):

Tube Outside Diameter (inches)	Maximum Hanger or Support Spacing (feet)	Minimum Rod Size (inches)
1/8 to 1/4	2	3/8
5/16 to 1/2	3	3/8
5/8 to 7/8	4	3/8
1 to 2	6	3/8

3.02 PIPE SUPPORT SPACING FOR SUPPORTS ON TOP OF SLABS OR GRADE

C.A.1 Install pipe supports on horizontal runs at the spacing shown or detailed in the drawings. Provide supports of the type shown or detailed in the drawings. If no spacings are given in the drawings or in the specifications for a particular piping system, use the following:

A. Pipe Support Spacing for Steel and Ductile-Iron Pipe (Sections 40 20 40 and 40 20 76):

Pipe Size (inches)	Maximum Support Spacing (feet)
3/8 and smaller	4
1/2 through 1	6
1 1/4 through 2	8
2 1/2 and 3	10
3 1/2 and 4	10
6	12
8	12
10 and 12	14
14 and 16	16
18	16
20 through 24	18
30	18

B. Pipe support spacing for other pipe materials shall be the same as described above in paragraph entitled “Pipe Hanger and Wall Support Spacing.”

3.03 INSTALLING PIPE HANGERS AND SUPPORTS

A. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.

B. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.

C. Adjust pipe hangers per MSS SP-89, paragraph 10.6.

D. Install leveling bolts beneath support baseplates. Provide 1-inch thick grout pad beneath each base.

E. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

3.04 INSTALLING STEEL AND FRP CHANNEL FRAMES

A. Use 1-5/8-inch-high channel frames unless 3-1/4-inch is needed to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

B. Seal the ends of cut FRP channel frames with the channel manufacturer's sealant or resin.

3.05 INSTALLING NEOPRENE ISOLATING SLEEVES

Install a sleeve around each metal pipe 6 inches and smaller at the point of bearing or contact with the pipe hanger or support.

3.06 PAINTING AND COATING

A. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.

B. Paint exposed pipe hangers and supports to match the color of the adjacent wall using per Section 09 90 00. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.

C. Coat submerged pipe hangers and supports per Section 09 90 00.

END OF SECTION

SECTION 40 07 75

EQUIPMENT, PIPING, DUCT, AND VALVE IDENTIFICATION

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials and installation of markers, labels, and signs for pipes, ducts, and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.

PART 2 MATERIALS

2.01 LABELS FOR EXPOSED PIPING

A. Labels for piping shall bear the full piping system name as shown in the Piping Schedule in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels for piping inside buildings shall be vinyl cloth: W. H. Brady Co. B-500 vinyl cloth, Seton Name Plate Corporation Pipe Markers, or equal. Labels for piping located outdoors shall be weather- and UV-resistant acrylic plastic and shall be W. H. Brady Co. B-946, Seton Name Plate Corporation Pipe Markers, or equal.

B. Alternatively, provide preprinted, semirigid, snap-on, color-coded pipe markers. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Label shall cover 360 degrees (minimum). Labels shall be fabricated of weather- and UV-resistant acrylic plastic. Labels shall be Seton Nameplate Corporation SetMark pipe marks or equal.

2.02 LABELS FOR EXPOSED VALVES

Provide each valve with an identification tag. Tag shall be 2-inch-square or circular aluminum or 1/16-inch-thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp.

Series SVT, or equal. PVC tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings.

2.03 LABELS FOR MECHANICAL EQUIPMENT

Provide a label for each pump, blower, compressor, tank, feeder, flocculator, flash mixer, clarifier mechanism, or other piece of mechanical equipment. Label shall show the equipment name and tag number as shown in the drawings. Labels shall be 1 1/2 inches (minimum) by 4 inches (minimum) brass, aluminum, or 1/8-inch-thick fiberglass tags: Brady B-120 Fiber-Shield, Seton Style 2065, or equal.

2.04 LABELS FOR EXPOSED TANKS

Signs shall be weather- and UV-resistant. Labels shall be Brady B-946, Seton Name Plate Corporation PSPL, or equal. Minimum size shall be 7 inches by 10 inches. Provide a sign on each tank bearing the tank tag number and the name of the liquid stored.

2.05 LABELS FOR AUTOMATIC START/STOP EQUIPMENT

Provide a sign reading "CAUTION--EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on each piece of equipment listed below. Signs shall be pressure-sensitive vinyl with adhesive for application to equipment. Signs mounted on adjacent walls are also acceptable. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

Equipment Type	Location	Tag Number
High Service Pumps	HSP Building	
NAOCL Metering Pumps	HSP Building	

2.06 HAZARDOUS MATERIALS WARNING AND DANGER SIGNS

A. Provide hazardous materials warning diamond signs complying with NFPA 704. Size shall be 10 inches square. Wall signs shall be 1/8-inch-thick fiberglass: Brady B-120 Fiber-Shield or equal. Signs attached to tanks, cabinets, or pieces of equipment shall be self-adhesive vinyl cloth: Brady B-946 or equal. Provide signs at the following locations:

Room No.	Tag Number	Tank or Equipment	
		Location	Chemical
		NaoCl Bulk Storage	12.5% Sodium Hypochlorite

B. Provide signs reading "DANGER" followed by the name of the chemical, gas, or hazard. Size shall be 10 inches by 14 inches. Signs shall be 1/8-inch-thick fiberglass: Brady B-120 or equal. Provide signs at the following locations:

Room No.	Sign Location	Name of Hazardous Material
	NaoCl Skid in HSP Building	12.5% Sodium Hypochlorite

2.07 LABELS FOR EXPOSED VENTILATION DUCTS

Identify air supply, return exhaust, intake, and relief ductwork with duct markers, showing ductwork service and direction of flow. Signs shall be pressure-sensitive vinyl with adhesive for application to ducts and duct insulation. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

2.08 UNDERGROUND PLASTIC WARNING TAPE FOR METALLIC PIPE

Provide permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service, not less than 6 inches wide by 3.5 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Fiber Optic	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue
Oxygen	Yellow

2.09 UNDERGROUND DETECTABLE METALLIC PIPE WARNING TAPE FOR NONMETALLIC PIPE

Provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Provide tape with printing which most accurately indicates type of buried service. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Fiber Optic	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue
Oxygen	Yellow

PART 3 EXECUTION

3.01 INSTALLING PIPE LABELS

A. Provide label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 20-foot centers on straight runs of piping.

B. On piping having external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.

C. On piping having external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers but not narrower than three times letter height (and of required length), fastened by one of the following methods:

a. Laminated or bonded application of pipe marker to pipe or insulation.

b. Strapped-to-pipe or insulation application of semirigid type with Type 304 or 305

stainless steel bands.

3.02 INSTALLING VALVE AND EQUIPMENT LABELS

A. Attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains or wires.

B. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

3.03 INSTALLING MISCELLANEOUS SIGNS

Attach per sign manufacturer's recommendations and per OSHA requirements.

3.04 INSTALLING WALL AND DOOR SIGNS

Attach to walls and doors using epoxy adhesive.

3.05 INSTALLING LABELS FOR AUTOMATIC START/STOP EQUIPMENT AND HAZARDOUS MATERIALS WARNING SIGNS FOR EQUIPMENT

A. Attach signs for exposed equipment directly to the equipment.

B. Attach signs for sump pumps on the adjacent wall.

3.06 INSTALLING VENTILATION DUCTWORK LABELS

A. In each space where ductwork is exposed or concealed only by a removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground, or similar concealment) and at 20-foot spacings along exposed runs.

B. Provide markers on each access door in ductwork and housings, indicating purpose of access.

C. Assure that all identification labels are clearly visible.

3.07 INSTALLING UNDERGROUND PLASTIC WARNING TAPE FOR METAL PIPE

During backfilling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches above the top of the pipe. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker.

3.08 INSTALLING UNDERGROUND DETECTABLE METALLIC PIPE WARNING TAPE

Install tape 4 to 6 inches below finished ground surface, located directly over buried pipelines. Where multiple small pipelines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker tape.

3.09 INSTALLING MARKER POSTS FOR UNDERGROUND UTILITIES

A. Install marker posts over the centerline of the utility.

B. Install marker posts at the following locations and points:

a. Every 500 feet along the utility alignment.

b. At each angle point exceeding 3 degrees in the utility alignment.

c. At each point where the utility passes beneath a paved road. Install marker post within 5 to 8 feet of the edge of the roadway paving.

d. At each point where the utility passes beneath a property line.

e. At each point where a utility passes beneath a building slab. Install marker post within 2 to 4 feet of the building wall or the edge of the slab footing. If paving is provided around the building, excavate a hole for the utility marker post, install marker post, and then backfill with earth and install paving. Install such that the marker posts do not interfere with site traffic.

END OF SECTION

SECTION 40 20 40

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION:

A. Provide and test ductile iron pipe, fittings and appurtenances as specified. Ductile iron pipe shall be limited to those areas identified and detailed on the drawings. Generally only ductile iron fittings and castings are being used on this project.

B. Options:

1. For buried exterior pipelines provide push-on joint pipe.

   a. Provide restrained push-on pipe as specified

   b. Provide either restrained push-on joint fittings as specified and indicated or provide mechanical joint fittings with restraint system as specified herein

2. For piping exposed as in buildings and galleries, provide flanged or rigid-joint, grooved-coupled pipe and fittings.

3. Cast iron pipe and fittings are not acceptable.

1.02 REFERENCES

A. American Society of Mechanical Engineers (AMSE):

1. B16.1: Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

2. B16.21: Nonmetallic Flat Gaskets for Pipe Flanges.

3. B16.42: Ductile Iron Pipe Flanges and Flanged Fittings.

4. B31.1: Power Piping.

B. American Society for Testing and Materials (ASTM):

1. A240: Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

2. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile.

3. A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.

4. A530: Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.

5. A774: Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

6. A778: Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

C. American Water Works Association (AWWA):

1. A21.4: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. A21.10: Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.

3. A21.11: Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.

4. A21.15: Flanged Ductile-Iron Pipe with Threaded Flanges.

5. A21.50: Thickness Design of Ductile-Iron Pipe.

6. A21.51: Ductile-Iron Pipe, Centrifugally Cast in Metal Molds, or Sand-Lined Molds, for Water or Other Liquids.

7. A21.53: Ductile-Iron Compact Fittings, 3-in through 16-in. for Water and Other Liquids.

D. Fluid Sealing Association: Technical Handbook.

1.03 SUBMITTALS:

A. Submit the following in accordance with General Conditions and Section 01 33 00:

1. Pipe manufacturer's technical specification and product data.

2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.

a. Pipe layouts in full detail.

b. Location of hangers and supports.

c. Location and type of anchors.

d. Location of couplings and expansion joints.

e. 1/2-inch = 1 foot-0 inch (25) scale details of all wall penetrations and special fittings.

f. Schedules of pipe, fittings, special castings, couplings, expansion joints and other appurtenances.

3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed.

4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.

5. Brochures and technical data on coatings and linings and proposed method of application.

6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.

B. Material Certification:

1. Provide certification from the pipe and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

C. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01 43 00 and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Inspect and test at foundry according to applicable standard specifications.

D. Owner reserves right to inspect and test by independent service at manufacturer’s plant or elsewhere at his own expense.

E. Visually inspect before installation.

F. Job Conditions:

1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.05 DELIVERY, STORAGE AND HANDLING:

A. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Owner. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

PART 2 PRODUCTS

2.01 PIPE:

A. Ductile Iron:

1. Design conforming to AWWA A21.50.
2. Manufacture conforming to AWWA A21.15 or AWWA A21.51.
3. Thickness class, unless otherwise indicated or specified:
    a. Minimum Thickness Class 52.
    b. Minimum thickness Class 53 for use with threaded flanges.
    c. Minimum thickness Class 53 for use with flanged pipe.

2.02 PIPE FOR USE WITH COUPLINGS:

A. As specified above except ends shall be plain.

B. With bolted split sleeve couplings, ends cast or machined at right angles to axis.

C. With grooved type coupling:

1. Ductile-Iron of thickness class specified above.

2.03 FITTINGS:

A. Buried ductile iron fittings on the AW-1 and FW-1 piping between the GSR and HSP station shall meet AWWA C110. All other buried ductile iron fittings may be compact ductile iron fittings meeting AWWA C153.

B. Provide fittings conforming to AWWA A21.10, at least Class 150 and match piping class.

C. Provide all bell push-on or mechanical-joint fittings unless otherwise indicated or specified.

D. Face and drill flanged fittings conforming to AWWA A21.10 except special drilling or tapping for correct alignment and bolting.

E. If flanged fittings are not available under AWWA A21.10 provide fittings conforming to ASME B16.1 in 125 lb. pressure class.

F. Provide standard base fittings where indicated.

2.04 NONSTANDARD FITTINGS:

A. Acceptable design.

B. Same diameter and thickness as standard fittings.

C. Manufactured to meet requirements of same specifications as standard fittings except for laying length and types of ends.

2.05 WALL CASTINGS:

A. Provide size and type indicated.

B. Wall Castings: Conform to requirements of AWWA A21.10 or fabricate of Class 53 ductile iron pipe with screwed on flanges and welded on waterstop.

C. Provide water stop centered in wall. Weld water stops on in factory under controlled conditions to ensure adequate strength to permit waterstop to absorb thrust up to the pressure rating of the pipe.

Wall Castings with annealed ductile iron water stops

Pipe Size	Waterstop thickness, in
4”-12”	0.50
14”-24”	0.75
30”-36”	1.00

Wall Castings with fabricated steel water stops

Pipe Size	Waterstop thickness, in
4”-16”	0.25
18”-24”	0.38
30”-36”	0.50

D. On flanged wall castings, provide space between the wall and flange to permit mounting the nuts on the flange bolts.

E. Flanged wall castings located with the flange flush with the wall are not acceptable.

F. Locate push-on joint wall castings with space between the bell and the wall to insert the follower bolts.

G. As an option, fabricated wall pipe of Schedule 40 Type 316L stainless steel may be substituted for wall castings specified above. Provide with waterstops of above dimensions and welded continuously on both sides of stop. Flanges of Type 316 stainless steel. Bolts for connection to buried pipe Type 316 stainless steel. Provide flange insulation gaskets, sleeves and washers for all flanges.

2.06 ADAPTERS:

A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.

1. Provide ends conforming to above specifications for the correct type of joint, to receive adjoining pipe.

2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.

2.07 JOINTS:

A. Provide push-on joint and mechanical joint pipe with necessary accessories, conforming to AWWA A21.11.

1. Provide gasket composition designed for exposure to liquid within pipe.

B. Provide pipe flanges and accessories conforming to AWWA A21.15.

1. Provide flat faced flanges.

2. Provide 1/8-inch (3 mm) thick, full faced gaskets designed for exposure to liquid within pipe.

C. Provide restrained joint on pipe and fittings where indicated. Provide restrained joint which is:

1. Boltless

2. Capable of being deflected after assembly

3. Designs using set screws or requiring field welding are not acceptable.

4. Manufacturers:

a. American Cast Iron Pipe Co. Flex-Ring.

b. U.S. Pipe TR FLEX.

c. Clow Super-Lock.

D. Restrained joints for outfall piping to the cooling reservoir 36 inches and larger shall be American Cast Iron Pipe "Lok-Ring", U.S. Pipe “HP Lok” or equal. Weldments for restrained joints shall be tested by the liquid penetrant method per ASTM E165. The method of retainage shall be a factory installed in the bell retainer band that provides a positive axial lock between the interior surface and a retainer weldment on the spigot end of the pipe.

2.08 MECHANICAL JOINT FITTINGS – RESTRAINT SYSTEM:

A. Provide restraint devices for pipe consisting of multiple gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, retaining full mechanical joint deflection during assembly and allowing joint deflection after assembly.

2. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

3. Provide restraint devices Listed by Underwriters Laboratories (3 inch (80 mm) through 24 inch (300 mm) size) and Designed by Factory Mutual (3 inch (80) through 12 inch (300 mm) size).

B. Working Pressure Rating:

1. 16-inch (400 mm) and Smaller: 350 psi (24 bar).

2. 18-inch (450 mm) and Larger: 250 psi (17.3 bar)

3. Minimum safety factor of 2 to 1.

C. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.

2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.

3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.

4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.

5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.

6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.

D. Manufacturer:

1. EBAA Iron MegaLug Series 1100

2.09 FLANGE ADAPTORS:

A. Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

2. Provide restraint devices Listed by Underwriters Laboratories (3-inch (80 mm) through 12 inch size) and Designed by Factory Mutual (4-inch (100 mm) through 12-inch size).

B. Joint Deflection capability:

1. 3-inch thru 8-inch: 5 degrees

2. 10-inch and 12-inch: 3 degrees

3. 14-inch and 16-inch: 2 degrees

4. 18-inch and 20-inch: 1.5 degrees

5. 20-inch, 42-inch and 48-inch: 1 degrees

6. 30-inch and 36-inch: 3 degrees

C. Provide flange adaptor to maintain seal with and 0.6 inch (15 mm) gap between end of pipe and mating flange

D. Working Pressure Rating:

1. 16-inch and Smaller: 350 psi)
2. 18-inch : 300 psi
3. 20-inch: 250 psi
4. 24-inch: 200 psi
5. 30-inch thru 48-inch: 150 psi
6. Minimum safety factor of 2 to 1.

E. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.
6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.

F. Manufacturer:

1. EBAA Iron MegaFlange Series 2100

2.10 FLEXIBLE CONNECTIONS:

A. Use as specified or indicated:

1. Bolted split sleeve couplings
2. Expansion joints

2.11 BOLTED SPLIT SLEEVE COUPLINGS:

A. Provide in accordance with Section 40 07 22.

B. Pressure rating at least equal to that of related pipeline.

C. Provide with gaskets of composition designed for exposure to liquid within pipe.

2.12 EXPANSION JOINTS:

A. Provide in accordance with Section 40 07 22.

B. Pressure rating at least equal to that of related pipeline.

2.13 FILLING RINGS:

A. Provide where necessary.

B. Materials, workmanship, facing, and drilling, conforming to 125-lb. ANSI (PN 10).

C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

2.14 CONNECTIONS – TAPPED:

A. Provide service saddles for all taps for lines 24-inch (600 mm) and smaller.

1. Body: Ductile iron ASTM A395 or Bronze.

2. Straps and Hardware: Type 316 stainless steel.

B. For 30-inch and larger provide watertight joint with adequate strength against pullout. Use only tapered thread taps.

1. Maximum size of taps in pipe or fittings without bosses not to exceed that listed in table of Appendix to AWWA A21.51 based on: 2 full threads.

2. Where size of connection exceeds that given above for pipe, provide boss on pipe barrel or use tapping saddle. Make tap in flat part of intersection of run and branch of tee or cross, or connect by means of tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, or permitted.

3. Provide taps and piping for gauges and pressure sensing instruments in accordance with ANSI/HI standards so that there are no erroneous readings.

2.15 STANDARD LINING AND COATING: - Fire water pipe only

A. Inside of pipe and fittings: Provide double thickness cement lining and bituminous seal coat conforming to AWWA A21.4.

B. Outside of pipe and fittings within structures: Clean and apply one shop coat with a 3 to 5 mil DFT of moisture cured urethane.

C. Outside surfaces of castings to be encased in concrete: No coating.

D. Machined surfaces cleaned and coated with rust-preventative compound at shop.

E. Outside of buried pipe and fittings: Standard bituminous coating conforming to AN Standard/AWWA C151.

2.16 GASKETS, BOLTS, AND NUTS:

A. Provide ring or full face synthetic rubber gaskets for flanged joints and neoprene faced phenolic for insulating gaskets in accordance with AWWA A21.11 and ASME B16.21.

1. 1/8 inch (3 mm) thick.

B. Make flanged joints with:

1. Bolts.

2. Bolt studs with nut on each end.

3. Studs with nuts where flange is tapped.

4. Plastic bolt sleeves and washers for insulating joints.

C. Number and size of bolts conform to same ANS as flanges.

D. Provide bolts and nuts, except as specified or indicated, Grade B, ASTM A307.

E. Provide bolt studs and studs of same quality as machine bolts.

F. Provide Type 316 stainless steel bolts, washers and nuts in the following areas:

1. Submerged

2. Wet Wells

3. Chemical Area

4. Piping exposed to weather

PART 3 EXECUTION

3.01 HANDLING AND CUTTING:

A. Mark pipe and fittings "Rejected" and remove from site when cracked or has received a severe blow.

B. If permitted, cut on sound barrel at a point at least 12 inch (300 mm) from visible limit of crack, at Contractor's expense.

C. Machine cut with milling type cutters, knives, or saws. Snap cutters, torch, or hammer and chisel NOT ALLOWED. Examine for possible cracks.

D. Chamfer cut ends if used for push-on joints.

E. Do not cut glass lined pipes.

3.02 INSTALLATION:

A. Visually inspect before installation.

B. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

C. Pitch piping toward low points. Provide for draining low points.

D. Before assembly, remove dirt and chips from inside pipe and fittings.

E. Pipe and Fittings:

1. Remove and replace defective pieces.

2. Clear of all debris and dirt before installing and keep clean until accepted.

3. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

4. Provide firm bearing along entire length of buried pipelines.

5. Do not allow deflection of alignment at joints to exceed permissible deflection as specified below:

PIPE DEFLECTION ALLOWANCES

Maximum permissible deflection, in.*

Maximum permissible deflection, in.*		
Size of pipe, in.	Push-on joint	Mechanical joint
4	19	31
6	19	27
8	19	20
10	19	20
12	19	20
14	11	13-1/2
16	11	13-1/2
18	11	11
20	11	11
24	11	9
30	11	9
36	11	8
42	7-1/2	7-1/2
48	7-1/2	7-1/2
54	7-1/2	0 (0)
*Maximum permissible deflection for 20-feet (6 meters) lengths; for other lengths in proportion of such lengths to 20-feet (6 meters).		

a. For push-on joint or similar pipe, clean bell of excess tar or other obstruction and wipe out before inserting next pipe spigot. Shove new pipe into place until properly seated and hold securely until joint completed.

b. Set castings to be encased in concrete accurately with bolt holes, if any, carefully aligned. Clean off rust and scale before setting.

F. Temporary Plugs: When pipe laying not in progress, close open ends of pipe with temporary watertight plugs. If water in trench, do not remove plug until danger of water entering pipe passed.

G. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.03 JOINTS AND COUPLINGS:

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.

2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

B. Bolted Joints:

1. Remove rust-preventive coatings from machined surfaces.

2. Clean pipe ends, sockets, sleeves, housings, and gaskets and smooth all burrs and other defects.

3. Use torque wrench to tighten to correct range of torque not to exceed values specified below:

TORQUE RANGE VALUES

Nominal pipe size, in	Bolt diameter, in	Range of torque, ft-lb
3	5/8	40-60
4-24, incl.	3/4	75-90
30, 36	1	100-120
42, 48	1-1/4	120-150

C. Flanged Joints:

1. Make up tight.

2. Do not put strain on nozzles, valves, and other equipment.

D. Mechanical Joints:

1. Wire brush surfaces in contact with gasket and clean gasket.

2. Lubricate gasket, bell, and spigot with soapy water.

3. Slip gland and gasket over spigot, and insert spigot into bell until seated.

4. Seat gasket and press gland firmly against gasket.

5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

E. Flexible Joints:

1. Clean and dry before assembly.

2. Place gaskets, rings, glands and followers in position in back of spigot ball.

3. Coat ball and socket with thin film of lubricant conforming to joint manufacturer's standards.

4. Insert ball and seat in socket. Seat gasket against ball.

5. Boltless joints:

a. Assemble retainer rings and glands conforming to manufacturer's standard.

b. Lock in place with lead strips.

F. Tapped Connection:

1. Drill and tap normal to longitudinal axis.

2. Drilled by skilled mechanics using proper tools.

3. Use only tapered threads.

3.04 FIELD TESTING:

A. Provide in accordance with Section 40 05 15.

B. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

C. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test in pipelines.

2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

3. Test when desired and comply with specifications.

4. Test pipelines in excavation or embedded in concrete before backfill or placing of concrete and test exposed piping before field painting.

5. Fill section of pipe with water and expel air. If hydrants or blowoffs are not available at high points for releasing air, make necessary taps and plug after test completion.

6. Maintain section full of water for 24 hours before conducting combined pressure and leakage test.

7. Conduct pressure and leakage test consisting of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to pipe pressure rating, but not more than 150 psi.

8. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section fails test.

9. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

10. Modify test procedure only if permitted by Owner.

3.05 FIELD PAINTING:

A. Provide in accordance with Section 09 90 00.

3.06 DISINFECTING AND FLUSHING:

A. Disinfect potable water lines using procedures and materials conforming to AWWA C651.

B. Dosage to produce minimum 10 ppm after minimum of 24 hour contact period.

C. After treatment, flush with clean water until residual chlorine content less than 0.2 ppm.

D. Prevent contamination of water in existing water mains. Neutralize chlorine content of water used in disinfecting and flushing accordance with AWWA C651.

END OF SECTION

SECTION 40 20 76

STAINLESS STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION:

A. This section includes materials and installation of stainless steel pipe and fittings 24 inches in diameter and smaller conforming to ASTM A312 and having a maximum design pressure of 150 psi.

1.02 REFERENCES:

A. American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.
2. B16.5: Pipe Flanges and Flanged Fittings
3. B16.11 Socket Welding Fittings

B. American Society for Testing and Materials (ASTM):

1. A182: Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
2. A240: Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
3. A312: Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
4. A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.
5. A403: Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
6. A530: Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
7. A774: Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

8. A778: Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

9. F2015: Standard Specification for Lap Joint Flange Pipe End Applications

C. Fluid Sealing Association: Technical Handbook.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01 33 00:

1. Pipe manufacturer's technical specification and product data.

2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.

a. Pipe layouts in full detail.

b. Location of hangers and supports.

c. Location and type of anchors.

d. Location of couplings and expansion joints.

e. 1/2-inch = 1 foot-0 inches (25) scale details of all wall penetrations and fabricated fittings or special fittings.

f. Schedules of pipe, fittings, expansion joints and other appurtenances.

3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed with appropriate standard.

4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.

5. Submit reports required for welding certifications per ASME B31.1 paragraph 127.6.

6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.

B. Material Certification:

1. Provide certification from the piping and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and

certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

2. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

C. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.04 QUALITY ASSURANCE:

A. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

B. Welder Qualifications:

1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

C. Job Conditions:

1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01 66 10.

B. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Owner's Representative. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

1. Ship, store, and handle piping (including both pipe and fittings) per AWWA C220, Section 6.2 and AWWA C226, Section 6.3 and the following.

2. When loading piping for shipment to the project site, use spacers and other protective devices to separate pipes to prevent damaging the surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the pipe surfaces after separation. Use padded chains or ribbon binders to secure the loaded pipe and minimize damage.

3. Cover piping 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

4. Provide stulls, braces, and supports during shipping and storage such that out-of-roundness or deflection does not exceed 0.5% of the pipe diameter.

5. Handle piping with care during unloading, installation, and erection operations to minimize damage. Do not place or store pipe on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place pipe above the ground upon platforms, skids, or other supports.

6. Store piping at the site on pallets to prevent direct contact with ground or floor. Cover pipe during storage with protective coverings or tarpaulins to prevent deposition of rainwater, salt air, dirt, dust, and other contaminants.

7. Do not allow piping to contact carbon steel surfaces during storage, handling, or installation and erection at the site.

PART 2 PRODUCTS

2.01 STAINLESS STEEL PIPE:

A. Manufacturers:

1. Douglas Brothers
2. Felker
3. Bristol MetalsDixie SouthernMaterial:

1. Type 316L
    a. Type 316L bar, sheet, and plate per ASTM A240.
    b. Maximum carbon content of 316L material limited to 0.03 percent.
    c. Finish: 2D.
2. Type 304L
    a. Type 304L bar, sheet, and plate per ASTM A240.
    b. Maximum carbon content of 304L material limited to 0.03 percent.
    c. Finish: 2D.

C. Butt Welded Fabrication:

1. Pipe 12-inch and smaller shall be seamless and fabricated in accordance with ASTM A312.
2. Pipe 14-inch and larger shall be straight seamed and fabricated in accordance with ASTM A778. Spiral welded pipe is not acceptable.
3. Pipe sizes and wall thickness shall conform to ASME B36.19 in NPS sizes shown with dimensional tolerances per ASTM A530.
4. Perform welding by qualified welders conforming to standard procedures. Weld piping with wall thickness up to 11 gauge, 0.125-inch, with the TIG (GTAW) process. Properly bevel heavier walls and use a root pass with the TIG (GTAW)

process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process.

5. Add filler wire of ELC grades to all welds to provide a cross section at the weld equal to or greater than the parent metal. Distribute smooth and evenly weld deposit and provide a crown of no more than 1/16-inch (1.5 mm) on the I.D. and 3/32-inch (on the O.D. of the piping.

6. Concavity, undercut, cracks or crevices are not acceptable.

7. Butt Welds: Full penetration to the interior surface, with inert gas shielding provided to the interior and exterior of the joint.

8. Remove excessive weld deposits, slag, spatter, and projections by grinding.

9. Continuously weld angle face rings on both sides to the pipe or fitting.

10. Grind all welds on gasket surfaces smooth.

11. Contour pipe branches, taps and bosses to the radius of the main pipe run and bevel and weld with full penetration. No projections to the inside of the branch or main run are acceptable. Provide a smooth transition from ID of run to ID of branch.

12. Wire-brush inside and outside weld areas with brushes of stainless steel that are specifically designed to be used only on stainless steel.

13. After manufacture, passivate stainless steel pipe, fittings, and appurtenances by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid. Temperature and detention time to be sufficient for removal of oxidation and ferrous contamination without more than superficial etch of surface. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by clean water wash. Perform in accordance with ASTM A380.

14. After fabrication, either passivate by immersion (see above paragraph) or scrub interior and exterior of welds with same solution or pickling paste and stainless steel wire brushes to remove weld discoloration and then neutralize and wash clean. Perform in accordance with ASTM A380.

15. Perform all welding in the shop. Field welding is not acceptable.

a. If field welding is allowed for certain circumstances, the Contractor shall submit the welders qualifications and an acceptable method of cleaning the pipe and fittings for review prior to start of any field welding.

b. All welds shall be annealed.

D. Fittings:

1. Fittings 2-inch and smaller shall be threaded or socket welded, conforming to ASME B16.11, 3,000-pound CWP. Material for threaded fittings shall conform to ASTM A403, Class WP 316 or ASTM A182, Grade F316. Material for socket welded fittings shall conform to ASTM A403, Class WP 316L or ASTM A182, Grade F316L.

2. Fittings for aboveground or exposed pipe larger than 2.5 inch and larger shall be flanged, Type 316L per ASTM A403, Class WP-S. Provide same material and wall thickness as the pipe, conforming to ASME B16.9. Elbows shall be long radius.

3. Fabricate tees and branch connections true and square with wall thickness same as pipe.

4. Reducers evenly tapered with tangent ends for butt weld connection.

5. Reducers may be straight tapered cone construction.

6. Secure flanges to pipe ends and plug openings prior to shipment.

7. All elbows shall be long radius.

E. Pipe:

1. Pipe smaller than 3 inches shall conform to ASTM A312, Grade TP 316L. Pipe 3 inches and larger shall conform to ASTM A312, Grade TP 316L.

2. Pipe sizes and wall thicknesses shall conform to ASME B36.19 as follows:

Pipe Size	Wall Thickness
1 inch and smaller	Schedule 80S
1 1/4 inches through 3 inches	Schedule 40S
3 1/2 inches through 8 inches	Schedule 10S
Larger than 8 inches, through 30 inches	Schedule 10S

3. Joints: Joints for pipes 2 inches and smaller shall be socket welded, same material as specified for fittings, 3,000-pound WOG, conforming to ASME B16.11. Joints for aboveground or exposed piping larger than 2 inches shall be flanged.

4. Hardware: Type 316 stainless steel.

5. Isolate stainless steel flanges from other ferrous metal connections at valves and equipment with flange insulating kit.

    a. Pipe flange insulating kit, double washer type:

        (1) Flange gasket: Type E, 1/8-inch (3 mm) thick neoprene-faced phenolic.

        (2) Insulating sleeves: 1/32-inch (0.8 mm) thick polyethylene, full length, one for each flange bolt.

        (3) Insulating washers: 1/8-inch (3 mm) thick phenolic, two for each flange bolt.

        (4) Mechanical washers: 1/8-inch (3 mm) thick Type 316 stainless steel, two for each flange bolt.

2.02 FLANGES

A. Materials for flanges shall conform to ASTM A182/A182M, Grade F316L F304L, match pipe material.

B. Provide weld-neck, socket weld, or lap joint flanges (conforming to ASME B16.5) for piping 3 inches and smaller to connect to flanged valves, fittings, or equipment. Provide Weld-Neck, Slip-On, or Lap Joint flanges (for piping larger than 3 inches. Flanges shall be Class 150 or 300 per ASME B16.5. Flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment.

C. Stainless steel flanges mating with cast iron, ductile iron, FRP, HDPE, and plastic flanges shall be flat face. Stainless Steel on Stainless Steel shall be raised faced.

2.03 BOLTS AND NUTS FOR FLANGES

A. Refer to Section 40 05 00 for bolts and nuts for stainless steel pipe flanges.

2.04 GASKETS

A. Refer to Section 40 05 00 for gaskets to be used for stainless steel piping.

2.05 PICKLING, PASSIVATING, AND FI NAL CLEANING

A. Pipe and fittings shall be final cleaned, pickled, and passivated per ASTM A380. Passivation shall be the removal of exogenous (not inherent in the base metal) iron or iron compounds from the surface of the stainless steel by means of a chemical dissolution, by a treatment with an acid solution that will completely remove the surface contamination but will not significantly affect the stainless steel itself. After final cleaning, wet surfaces with water and inspect for rust spots after 24 hours. Reclean if there is any evidence of rusting.

2.06 EXTERIOR AETHETIC FINISH

A. Where shown in the drawings Piping Schedule, exterior finish for piping 6 inches and larger shall be equivalent to a No. 4 per ASTM A480. As an alternative, provide a bright electropolished finish per ASTM B912. The electropolished surface shall pass the test for visual defects per ASTM B912, paragraph 5.1.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

B. Pitch piping toward low points. Provide for draining low points.

C. Before assembly, remove dirt and chips from inside pipe and fittings.

D. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped.

1. Except as otherwise specified, provide number and size of bolts conforming to same ANSI standards.

2. Provide Type 316 or 304 stainless steel hardware to match the pipe.

3. Provide ring gaskets of materials designed for the service specified and indicated, 1/16-inch thick gaskets.

4. Make up flanged joints tight with care being taken to prevent undue strain upon valves or other pieces of equipment.

3.02 FIELD TESTING:

A. Clean of dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test in pipelines.

2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

3. Test when desired and comply with Owner's Representative orders and specifications.

4. Fill section of pipe with water and expel air.

5. Pressure and leakage test consists of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi (bar) numerically equal to test pressures indicated in the Process Pipe Schedule.

6. No visible leakage in joints.

7. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section failed to pass test.

8. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

9. Immediately upon completion of testing, drain and dry piping to remove all traces of water and condensation.

10. Modifications to test procedure only if permitted by Owner’s Representative.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01 78 00.

END OF SECTION

SECTION 40 20 78

STAINLESS STEEL TUBING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of stainless steel tubing and fittings 2 inches in diameter and smaller.

B. Stainless steel pipe may be substituted for stainless steel tubing. However, tubing may not be substituted for pipe.

C. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.

D. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's catalog data for swaged fittings and joints.

E. Submit fitting manufacturer's instructions for assembling fittings and joints.

PART 2 MATERIALS

2.01 TUBING

A. Tubing shall conform to ASTM A269, Grade TP 316, seamless. Hardness shall not exceed Rockwell B80. Tube wall thicknesses shall be as follows:

Tube O.D. (inches)	Minimum Wall Thickness (inches)
1/8	0.028
3/16	0.028
1/4	0.028
5/16	0.035
3/8	0.035
1/2	0.042
5/8	0.058
3/4	0.065
7/8	0.072
1	0.083
1 1/4	0.109
1 1/2	0.134
2	0.165

B. Tubing shall be free of scratches. Tubing shall be suitable for bending and flaring.

C. Tubing shall be heat-treated, which shall consist of quenching in water or rapidly cooling by other means at a rate sufficient to prevent precipitation of carbides, as demonstrated by the capability of passing practice ASTM A262, Practice E (Supplementary Requirement S4 in ASTM A269).

2.02 FITTINGS AND JOINTS

A. Fittings and joints shall be of the SWAGELOK type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. Fitting and joint material shall comply with ASTM A479, Type 316, or ASTM A182, Grade F316. End connections shall be of the union type.

B. Joints connecting two straight tubes together shall be of the nut and ferrule union type.

2.03 PROTECTIVE END CAPS

Provide protective end caps on each piece of tubing, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each fitting, or ship and store fittings in sealed boxes or containers.

2.04 OUTLETS AND NOZZLES

Use a tee with nut and ferrule union ends to connect to the tubing and with an outlet to match the connecting valve or instrument.

2.05 CONNECTIONS TO THREADED-END VALVES

When connecting tubing to threaded-end valves, provide tube to female NPT connectors. Provide a threaded Schedule 80S Type 316 stainless steel nipple (ASTM A312, seamless) between the connector and the valve end.

PART 3 EXECUTION

3.01 INSTALLING TUBING

A. Do not drag tubing out of tube racks. Do not drag tubing across any surface that could scratch it.

B. Keep tube cutters and saws sharp. Do not cut too deeply with each turn of the cutter or motion of the saw.

C. Deburr tube ends before inserting into fittings and joints. Clean both the inside and outside of fitting and pipe ends before making up joints. Do not miter joints for elbows or notch straight runs of pipe for tees. Do not kink tubing.

D. Bends in tubing shall be long sweep. Provide the straight length of tubing recommended by the fitting and joint manufacturer to allow the tube to be inserted into the fitting. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point. Do not use bends to make turns greater than 45 degrees. Use fittings to make turns greater than 45 degrees.

3.02 INSTALLING BURIED TUBING

Install in accordance with Section 31 23 33.

3.03 INSTALLING EXPOSED TUBING

A. Install tubing without springing, forcing, or stressing the tubing or any adjacent connecting valves or equipment.

B. Provide pipe hangers and supports as specified in Section 40 07 64.

3.04 INSTALLING FITTINGS AND JOINTS

A. Follow the manufacturer's instructions for installing fittings and joints.

B. For fittings and joints larger than 1 inch, use the manufacturer's hydraulic swaging unit to make up the connections.

3.05 COATING BURIED TUBING

Coat buried tubing per Section 09 90 00.

3.06 INSTALLING WRAPPED OR COATED TUBING

Install buried tubing having wrapped coatings by extending the wrapping to the first joint after entering a building, penetrating a slab, or 6 inches above finished grade. Wrap joints spirally with a minimum overlap of 50% of the tape width.

3.07 FIELD HYDROSTATIC TESTING

A. See Section 40 05 15.

B. Do not allow test water to remain in the tubing for more than five days. Drain and dry the tubing after completing the testing.

END OF SECTION

SECTION 40 92 10

ELECTRIC MOTOR ACTUATORS FOR VALVES AND SLIDE GATES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of electric motor actuators for valves and slide and sluice gates.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Interior Painting: 09 91 23

B. Manual, Check, and Process Valves: 40 05 20.

C. Pipe Hangers and Supports: 40 07 64.

D. Equipment, Piping, Duct, and Valve Identification: 40 07 75.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Submit manufacturer's catalog data showing motor actuator parts and materials of construction, referenced by AISI, ASTM, SAE, or CDA specification and grade. Show motor actuator dimensions and weights. Identify each valve and actuator combination by tag number to which the catalog data and detail sheets pertain. Show coatings.

C. Show the maximum torque required to open and close each motor-actuated valve or slide gate.

D. Submit certified factory performance test records.

E. Submit motor data including nameplate data, insulation type, duty rating, and torque output at duty rating.

F. Submit electrical schematic drawings and wiring diagrams showing physical locations of components.

PART 2 - MATERIALS

2.01 ACTUATOR IDENTIFICATION

A. Motor actuators shall have the name of the manufacturer cast or molded onto the actuator body or shown on a permanently attached plate in raised letters.

2.02 ACTUATOR TAGGING

Provide identifying tags for electric motor-actuated valves and slide gates per Section 400775. Show valve or slide gate actuator tag number, name or designation as shown in the drawings, and valve size. Attach tags to actuators by means of stainless steel or copper wire.

2.03 ACTUATOR DESIGNATIONS AND DESIGNS

Actuator designations consist of a type number (1, 2, or 3) and one or more suffix letters. The number and the letters are intended to be compatible and the actuator shall meet the requirements of all.

Suffix	Description
None (basic design)	15-minute duty cycle (Type 1 actuators);minimum 75% duty cycle; NEMA 4 enclosure (motor, controls, push buttons); open-stop-close or throttling operation; 480-volt, 60-hertz, 3-phase power supply (Type 1 actuators) valve to remain in last position upon loss of control signal. Any of these basic requirements may be modified or superceded by suffixes (described below).
A	30-minute duty cycle.
B	NEMA 4X enclosure (motor, controls, push buttons).
C	NEMA 6 enclosure (motor, controls, push buttons). Design for 24 hours' continuous submergence at a depth of 20 feet.
D	NEMA 7 enclosure (motor, controls, push buttons).

E	NEMA 7, Class I, Division 1, Groups C and D enclosure (motor, controls, push buttons).
F	NEMA 9, Class II, Division 1, Groups E, F, and G enclosure (motor, controls, push buttons).
J	Class 1 throttling/modulating service per AWWA C542.
K	Class 2 throttling/modulating service per AWWA C542.
L	Class 3 throttling/modulating service per AWWA C542.
M	Class 4 throttling/modulating service per AWWA C542.
N	Modulating service; size motors for continuous duty; feedback potentiometer and integral electronic positioner/comparator circuit to maintain valve position; 4- to 20-mA d-c input signal to control valve in remote or auto position; auxiliary contact which closes when the local-off-remote switch is in the remote or auto position; valve position transmitter that generates 4- to 20-mA d-c signal proportional to valve position and is capable of driving into loads up to 1,000 ohms at 24-volt dc; valve closes upon loss of control signal.
O	Valve closes upon loss of control signal.
P	Valve incorporates a spring return to close upon loss of power.
Q	240-volt, 60-hertz, 3-phase, a-c power supply.
R	120-volt, 60-hertz, single-phase, a-c power supply.
S	220-volt, 60-hertz, single-phase, a-c power supply.
U	Slide wire (potentiometer) position transmitter.
V	Position transmitter with 4- to 20-mA output signal.

Thus, an actuator designated as “Type 1ADL” would be a Type 1 motorized actuator and have all the requirements described and specified for those suffix letters.

2.04 ACTUATOR TORQUE REQUIREMENTS

A. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve or slide gate at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve or slide gate assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve or slide gate manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve or slide gate operating stem or shaft.

B. Maximum torque shall include seating or unseating torque, bearing torque, dynamic torque, and hydrostatic torque. Assume that the differential pressure across the valve or slide gate is equal to the pressure or head rating of the valve or slide gat.

C. Assume a maximum pipeline fluid velocity of 16 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

2.05 DESIGN OF TYPE 1 ELECTRIC MOTOR ACTUATORS

A. Actuators shall comply with AWWA C542, except as modified herein. Output capacity of motors shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Motors shall have Class F or H insulation system. Provide motor with torque output (at duty rating) that exceeds the requirements of the following paragraphs including safety factor.

B. Design the actuator to move valves from fully closed to fully open in the time specified in the subsection on “Service Conditions.”

C. Design actuators mounted on slide gates to move the gates from fully open to fully closed in five minutes or less at a rise rate of 12 inches per minute.

D. Provide a reversing starter, three overloads (one in each ungrounded leg) or two motor thermal cutouts, 120-volt control power transformer, local-off-remote selector switch, stop-open-close push buttons, and open and closed indicator lights. Provide magnetic starters in actuators for open/close operation and solid-state starters in actuators for

modulating operation. Provide dry contact for remote indication of the actuator mode of operation. The contact shall be closed when the local-off-remote selector switch is in the remote position and the internal control power exists.

E. Provide a separate (remote) NEMA 4 enclosure with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6 feet 6 inches above floor or deck in lieu of integral controls.

F. Do not use external conduit for wiring any components within the actuator.

G. Gear actuators shall be totally enclosed and factory-grease packed or oil lubricated. The power gearing shall consist of helical gears of heat-treated steel. Worm gears shall be alloy bronze accurately cut with a hobbing machine. Worm shall be hardened steel alloy. Design gears for 24-hour continuous service with an AGMA rating of 1.50.

H. Position switches shall be integrally geared to the actuator and shall be adjustable and capable of actuation at any point between fully opened and fully closed positions. The position switches shall operate while the actuator is either in manual or in motor operation. Provide motor actuators with position switches capable of being separately used to provide remote indication of end of travel in each direction and to stop motion at the end of travel in each direction.

I. Provide two individually adjustable torque switches to protect the valve or slide gate and motor against overload in the opening and closing directions. To prevent hammering, the torque switch shall not reclose until the valve or slide gate is made to travel in the opposite direction.

J. Provide a manually operated handwheel that shall not rotate during electrical operation. In the event electrical power is interrupted, handwheel operation shall be activated by a hand lever attached to the mechanism. While the valve or slide gate is being operated manually, the motor shall not rotate. Upon restoration of electrical power, the handwheel shall automatically disengage. Design the handwheel diameter such that hand operation will not damage the valve or slide gate.

K. The position switch and torque switch contacts shall be capable of interrupting at least 0.2-ampere inductive load at 125-volt dc or 6-ampere inductive load at 120-volt ac.

L. Provide a lost motion device for open/close operation to permit the motor to reach full speed before the load is applied. Provide lost motion action for manual operation also. Do not provide lost motion device for modulating applications.

M. Provide minimum 10-watt space heater mounted in the actuator housing to prevent condensation and maintain the temperature in the actuator housing 5 degrees above the ambient temperature in the structure. Heater shall be on at all times.

N. Motor shall de-energize in the event of a stall when attempting to unseat a jammed valve.

O. Provide a time delay to prevent instant reversal of the actuator motor.

P. Provide terminal connections for external remote controls fed from an internal 24-volt or 120-volt supply.

Q. Provide two separate 1/2-inch conduit connections for control and power wiring.

R. Electric motor actuators shall be Limitorque Model SMB or L120, EIM, Rotork "Syncropak" or “IQ,” AUMA Series SA, or equal. Type 1 actuators on the project shall be of one manufacturer.

PART 3 - EXECUTION

3.01 SERVICE CONDITIONS

Gate Tag Number	Actuator Type or Designation	Fluid	Max. Flow (gpm)	Max. Dif. Press. (psi)	Opening/ Closing Time (seconds)	Separate (Remote) Control Enclosure Required?
						[Yes][No]
						[Yes][No]
						[Yes][No]
						[Yes][No]
						[Yes][No]
						[Yes][No]

3.02 FACTORY PERFORMANCE TESTING OF MOTOR ACTUATOR

Test each actuator prior to shipment in accordance with AWWA C542, Section 5.3. The application torque shall be the maximum torque required to open or close the slide gate at any position including seating and unseating conditions.

3.03 PAINTING AND COATING

Coat electric motor actuator the same as the slide gate to which it is attached. If the slide gate is not coated, coat actuator per Section 099000. Apply the specified prime and intermediate coats at the place of manufacture and finish coats in the field. Color of finish coat shall match the color of the slide gate to which the actuator is attached. If the actuator is attached to a submerged valve or to an uncoated slide gate, color of finish coat shall match the color shown in the Piping Schedule in the drawings for the particular piping service be OSHA Safety Green and JEA Standard Coloring Schedule.

3.04 SHIPMENT, STORAGE, AND TEMPORARY INSTALLATION BEFORE START-UP

A. Prepare equipment for shipment per AWWA C542, Section 6.2 and the following. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

B. Identify the equipment with item and serial numbers and project equipment tag numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number and project equipment tag numbers of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

C. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

D. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of manufacture prior to shipping.

F. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

G. If actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the actuator electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Exercise each actuator from its fully open to fully closed position at least once every seven days. Inspect electrical contacts before start-up.

3.05 FLOOR STANDS AND EXTENSION STEMS

Where shown in the drawings, mount the electric motor actuators on floor stands with extension stems as specified in Section 400520.

3.06 ATTACHING ELECTRIC ACTUATORS

The slide gate manufacturer shall mount the electric motor actuator and accessories on each slide gate and stroke the slide gate prior to shipment. Adjust limit switch positions and torque switches.

3.07 FIELD INSTALLATION

Install the valve and actuator as indicated in the drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

3.08 FIELD TESTING OF MOTOR ACTUATORS

A. Test motor actuators as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions. The measured current shall not exceed the current measurement recorded during the factory performance test.

B. If the measured current drawn exceeds the above value, provide a larger motor or gear drive or adjust the actuator so that the measured amperage does not exceed the value.

C. Assure that limit switches are placed at their correct settings. Open and close slide gates twice and assure that limit switches function.

END OF SECTION

SECTION 40 95 00

PROCESS INSTRUMENTATION AND CONTROL SYSTEM (PICS)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Work includes engineering, installing and furnishing field instruments and a Process Control Panel (PCP) at the JEA Timuquana Road Master Wastewater Lift Station. JEA is henceforth referred to as OWNER.

B. All programming associated with the PICS equipment shall be performed by OWNER.

C. The Instrumentation and Controls Sub-Contractor, henceforth referred to as the SYSTEM SUPPLIER must be a JEA Approved Tier One company listed on the JEA standards as of the bid due date. The following SYSTEM SUPPLIERS are approved as Tier One JEA I&C Integrators:

1. Information Technologies Group, (ITG) | James Ruiz (904) 425-4760 jruiz@itgtec.com

2. DSI Innovations LLC. | Sean Patterson (336) 893-8385 spatterson@dsiinnovations.com

3. Tesco Controls | Kyle Hady (916) 395-8800 khady@tescocontrols

D. The SYSTEM SUPPLIER shall also be responsible for the Work specified in the following Specification Sections:

1. Specification Section 40 95 10 defines field instruments.

2. Specification Section 40 95 20 defines work associated with the Process Control Panel (PCP) that will interface the system with the field instruments defined hereunder.

3. VFDs under specification section 26 29 23 are to be furnished by the SYSTEM SUPPLIER and installed by the CONTRACTOR.

E. It is the ultimate responsibility of the SYSTEM SUPPLIER to furnish a complete and fully operable PCP that reliably performs the specified functions. It is the

intent of these Contract Documents that the SYSTEM SUPPLIER have overall responsibility for designing, furnishing, interfacing, adjusting, testing, documenting, and checking out the PICS equipment described in the Contract Documents.

F. Equipment storage and protection until installed shall follow the storage and handling instructions recommended by the SYSTEM SUPPLIER. Anti-static and winterization requirements shall be per the SYSTEM SUPPLIER's instructions and the SYSTEM SUPPLIER shall periodically verify that these instructions are followed.

G. The SYSTEM SUPPLIER shall observe and advise on the installation of the PICS to the extent required to certify, with the operational check-out tests, that the equipment will perform as required.

H. All engineering development required by the SYSTEM SUPPLIER will be in accordance with the Conditions of this Contract.

I. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.

1.02 SYSTEM DESCRIPTION

A. The PICS shall include a Master Lift Station Control Panel, SCADA Radio Panel and field instruments.

B. The Master Lift Station Control Panel shall consist of the control devices, Siemens 6Es7 PLC, Siemens TP Touch Screen, and all necessary accessories, wiring and terminal blocks. The panel shall operate on a 120 volt AC control voltage with Uninterruptible Power Supply and include any necessary control transformers for lower voltages with proper grounding. The panel shall be approximately 90 inch high x 48 inch wide x 20 inch deep, NEMA 12 Rated with ANSI-61 Gray Polyester Powder coat finish inside and out.

C. SCADA Radio Panel shall consist of a MDS TransNET 900 Radio, UPS and all necessary accessories, wiring and terminal blocks. The panel will operate on a 120 volt AC control voltage. The panel shall be approximately 22 inch high x 18 inch wide x 10 inch deep and fabricated from fiberglass.

D. Field instruments as shown on the Contract Drawings shall interface the process with the PICS.

1.03 RELATED WORK

A. Specification Section 23 32 12 “Generator” defines requirements associated with the equipment to be interconnected with the PLC.

B. Specification Section 26 29 23 “Variable Frequency Drives” defines requirements associated with the equipment to be interconnected with the PLC via Profibus.

1.04 SUBMITTALS

A. Furnish, as prescribed under the General Requirements, all required submittals covering the items included under this section and its associated sections of the work.

B. Submit complete, neat, orderly, and indexed submittal packages. Handwritten diagrams are not acceptable and all documentation submittals shall be made using CADD generated utilities.

C. Partial submittals or submittals that do not contain sufficient information for complete review or are unclear will not be reviewed and will be returned by the ENGINEER as not approved.

D. Provide all shop drawing submittals electronically in PDF format.

E. Provide a single PICS shop drawing submittal containing the following:

1. Loop diagrams, consisting of complete wiring and/or plumbing diagrams for each control loop showing all terminal numbers, the location of the dc power supply, the location of any booster relays or common dropping resistors, surge arrestors, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus divide each loop diagram into four areas for identification of element locations: PLC I/O point(s), panel face, back-of-panel, and field, respectively.
2. System interconnect diagram that shows all connections required between component parts of the items covered in this section and between the various other systems specified in this Contract. Number all electrical terminal blocks and field wiring. Identify each line at each

termination point with the same number. Do not use this number again for any other purpose in the complete control scheme.

3. OWNER standard Master Lift Station and SCADA Panel drawings indicating all modifications applicable to the specific site. For all other control panels and enclosures, provide layout diagrams. Include panel elevations (front, side, interior), and sizing. Panel front elevations shall be of sufficient scale to allow all engraved nameplates and inscriptions to be legible without the use of schedules.
4. Wiring diagrams for all control panels. Diagrams shall be complete electrical wiring diagrams showing all components and all auxiliary devices such as relays, alarms, fuses, lights, fans, heaters, etc. All wires and terminals shall be numbered on the diagrams, and line cross-references shall be labeled. Include wiring interface to the PLCs where applicable. Include on these drawings a tag number to identify each component and referenced to a component identification list
5. Bill of Materials: A list of all components, including all 3rd party software. Group components by type and include component model number and part number, component description, quantity supplied, and reference to component catalog information.
6. Descriptive Information: Catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, power consumption, and heat dissipation of all elements. Clearly mark all options and features proposed for this project.
7. Installation Details. Equipment installation drawings showing external dimensions, enclosure material and spacing, mounting connections, and installation requirements.
8. A bill of material list of, and descriptive literature for, spares and expendables.

F. Test Procedures: Submit the procedures proposed to be followed during all system testing. Procedures shall include test descriptions, forms, and check lists to be used to control and document the required tests.

G. Test Reports: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures to the ENGINEER.

1.05 FINAL DOCUMENTATION

A. As a part of the final acceptance requirements, submit the PICS record drawings. Record drawings shall include, corrected for any changes that may have been made up through Substantial Completion:

1. instrument loop wiring diagrams
2. panel wiring diagrams
3. panel elevations
4. interconnection diagrams showing terminal numbers at each wiring termination

B. Record drawings shall be developed or converted to the latest version of AutoCAD. Provide AutoCAD files on a CD/DVD-ROM.

C. Operating and Maintenance (O&M) Manuals: Provide two complete sets of three-ring bound O&M manuals. Include descriptive material, drawings, and figures bound in appropriate places. Include:

1. Cross references to 3rd party O&M manuals.
2. Additional operating and maintenance instructions in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration and maintenance of each component provided with the PICS.
3. All the submittal data for each component from the approved shop drawing submittals with corrections made on approved as noted items.
4. A CD/DVD-ROM containing the shop drawing data in PDF format in the binder sleeve.

1.06 QUALITY CONTROL

A. The SYSTEM SUPPLIER shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.

B. All equipment furnished by the SYSTEM SUPPLIER shall be of the latest and most recent design and shall have overall accuracy as guaranteed by the manufacturer.

C. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.

D. Component equipment shall be as supplied by one of the manufacturers named or approved equal. The design of the PICS is based on the first-named manufacturer's equipment if there is a difference.

E. To facilitate the OWNER's operation and maintenance, products shall be of the same major MANUFACTURER, with panel mounted devices of the same type and model as far as possible.

F. In order to insure the interchangeability of parts and the maintenance of quality, strict compliance with the above requirements shall be maintained.

G. The SYSTEM SUPPLIER shall designate a single point of contact for interface with the ENGINEER on this project. The ENGINEER reserves the sole right to approve or reject this point of contact.

H. The SYSTEM SUPPLIER shall provide experienced personnel on-site to coordinate and/or perform installation, termination, and adjustment, on-site testing and startup assistance for the PICS.

1.07 STANDARDS

A. The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.

B. International Society of Automation (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the PICS.

C. Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that the equipment famished has been manufactured in accordance with the National Electric Code and OSHA requirements.

D. All Work shall meet the requirements of OWNER standards for wastewater pumping stations.

E. Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the OWNER.

1.08 WARRANTY AND GUARANTEES

A. The SYSTEM SUPPLIER shall furnish to the OWNER a written two year guarantee commencing with substantial completion, that all equipment and parts thereof, material and/or workmanship are of top quality and free from defects.

B. The SYSTEM SUPPLIER shall guarantee all equipment provided under these specifications.

PART 2 PRODUCTS

2.01 GENERAL

A. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.

B. Electronic equipment shall utilize printed circuitry suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

C. All equipment shall be designed to operate on a 60-Hertz alternating current power source at a normal 120 volts, plus or minus 10 percent, except where specifically noted otherwise. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

D. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single MANUFACTURER, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.

E. The equipment furnished shall be designed to operate satisfactorily between 0 degrees C and 40 degrees C at up to 95 percent Relative Humidity (non-condensing).

F. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 volts-amperes (VA), unless specifically noted otherwise.

G. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

2.02 LIGHTNING/SURGE PROTECTION

A. Surge protection devices and lightning arrestors meeting the requirements of ANSI Standard C-62.41 (latest revision) shall be provided as further detailed below.

B. Profibus Connections. Each Profibus drop shall be furnished with a 2-wire RS-485 surge protector. Provide Citel DLA-12D3, no equal.

C. AC Powered Instruments. Lightning and surge protection shall be provided on both the AC power supply and signal lines. The instrument, a breaker and the surge suppressor shall be mounted on a ½-inch aluminum plate. Outdoor instrument mounting plates shall also be equipped with 1/8 inch sun shields on top and both sides with front panel facing north wherever practical. The protectors shall meet the following criteria:

1. NEMA 4X small case.
2. Response time of less than five nanoseconds.
3. AC Power protection: IEEE/ANSI Std. C-62.41 rated C3 at 330 Volts clamping level.
4. Signal line protection: 10,000 Amp 8 x 20 microsecond surge, clamped at 36 Volts clamping level.
5. Test jacks for low level signal monitoring.
6. Manufacturer/model: Citel DS41S-120, no equal.

D. Loop Powered Instruments. Lightning and surge protection shall be provided on the 4-20 mA DC signal line. The protectors shall meet the following criteria:

1. Encapsulated in 316 Stainless Steel Pipe nipples for in-line conduit mounting.
2. Response time of less than one nanosecond.
3. Capable of withstanding up to 10 occurrences of 8/20 microsecond impulses at 5000 Amps.
4. Protection of both lines plus shield
5. Manufacturer/model: Citel model DLAW-24D3, no equal.

E. Signals. Lightning and surge protection shall be provided on all 4-20 mA and discrete signal wires entering or leaving the panel. The protectors shall meet the following criteria:

1. 35 mm DIN rail mounted with spring terminals.
2. Response time of less than one nanosecond.
3. Operating signal voltage: as required for signal type.
4. Capable of withstanding up to 10 occurrences of 8/20 microsecond impulses at 10,000 Amps.
5. Nominal series resistance of less than 2 ohms each leg
6. Manufacturer/model:
   a. Citel model DLA series, no equal.

F. Single phase AC Power (to 15Amps). Lightning and surge protectors for AC power supply lines up to 15 Amps service shall meet the following criteria:

1. Serial protection with replaceable fuse.
2. Failure indicator
3. Response time of less than five nanoseconds.
4. Capable of withstanding up to 10,000 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.
5. Manufacturer/model:
   a. Citel DS41S-120
   b. No equal.

2.03 SPARES AND EXPENDABLES

A. Provide the following spare parts:

1. Five (5) spare surge protection device of each type provided.

PART 3 EXECUTION

3.01 GENERAL

A. Prerequisite Activities and Lead Times: Do not start the following key project activities until the listed prerequisite activities have been completed and lead times have been satisfied:

1. Hardware Purchasing, Fabrication, and Assembly: Associated design related submittals completed (no exceptions, or approved as noted).
2. Shipment: Completion and approval of all design related submittals.
3. Startup: Operational Checkout Tests.

B. Substantial Completion: The following requirements must be fulfilled before consideration will be given for Substantial Completion of the PICS:

1. All PICS submittals have been completed.
2. The PICS has successfully completed the Demonstration Tests.
3. All spares, expendables, and test equipment have been received by OWNER.

3.02 PRODUCT HANDLING

A. Adequately pack manufactured material to prevent damage during shipping, handling, storage and erection. Pack all material shipped to the project site in a container properly marked for identification. Use blocks and padding to prevent movement.

B. Ship materials that must be handled with the aid of mechanical tools in wood-framed crates.

C. Ship all materials to the project site with at least one layer of plastic wrapping or other approved means to make it weatherproof. Anti-stat protection shall be provided for all sensitive equipment.

D. Inspect the material prior to removing it from the carrier. Do not unwrap equipment until it is ready to be installed. If any damage is observed, immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition, and any subsequent

damage that is discovered shall be repaired and replaced at no additional expense to the OWNER.

E. Store and protect equipment until installation following the storage and handling instructions recommended by the equipment manufacturers. Place special emphasis on proper anti-static protection of sensitive equipment.

F. ESD Protection: Provide for the proper handling, storage, and environmental conditions required for the PCP components deemed static sensitive by the equipment manufacturer. Utilize anti-stat wrist straps and matting during installation of these items to prevent component degradation.

G. Protection During Construction: Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the SYSTEM SUPPLIER's recommendations.

H. Corrosion Protection: Protect all consoles, panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, include capsules in the shipping containers, and equipment as recommended by the capsule manufacturer. During the construction period, periodically replace the capsules in accordance with the capsule manufacturer's recommendations. Replace all capsules just prior to Final Acceptance.

I. The CONTRACTOR shall be responsible for any damage charges resulting from the handling of the materials.

3.03 INSTALLATION

A. Install the PICS in the location indicated on the Drawings and follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instruction, and these Contract Documents, follow ENGINEER's decision, at no additional cost. Keep a copy of manufacturers' instructions on the jobsite available for review at all times

B. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Coordinate I&C work with the OWNER and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.

C. Provide finish on instruments and accessories that protects against corrosion by the elements in the environment in which they are to be installed. Finish both the interior and exterior of enclosures. Provide extra paint of each color used in the material from the manufacturer for touch-up purposes.

D. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.

E. Ground each analog signal shield on one end at the receiver end only. Properly ground all surge and transient protection devices. Coordinate grounding system with Division 16, Electrical.

F. For the purposes of uniformity and conformance to industry standard, provide analog signal transmission modes of electronic 4-20 ma DC. No other signal characteristics are acceptable.

G. Fully isolate outputs for transmitted electronic signals between transmitters and receivers, equipment of different manufacturers and between control panels to conform to ISA Standard S 50. 1.

3.04 TESTING – GENERAL

A. The ENGINEER reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.

3.05 OPERATIONAL READINESS TEST

A. These inspections and tests shall include Loop/Component inspections and tests. The SYSTEM SUPPLIER shall fully debug problems in the system as a whole.

B. Check the entire PICS for proper installation, calibration and adjustment on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and the PICS Specifications.

C. The Loop/Component Inspections and Tests shall be implemented using approved forms and checklists. These shall be developed by the SYSTEM SUPPLIER and submitted for approval.

D. Loop Status Report: Each control loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the SYSTEM SUPPLIER:

1. Project Name
2. Control Loop Number or description
3. Tag Number or description for each component of the control loop
4. Check-offs/sign-offs for each component for proper installation, termination, and calibration/adjustment
5. Check-offs/sign-offs for the control loop for proper panel interface terminations, 1/0 interface terminations, I/0 signal operation relative to the computer network, and total loop operation ready
6. Space for comments

E. Maintain the Loop Status Reports and Component Calibration Sheets at the jobsite and make them available to the ENGINEER at any time.

F. Witnessing: These inspections and tests do not require witnessing. However, the ENGINEER will review the Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Check-out Tests. Correct any deficiencies found.

END OF SECTION

SECTION 40 95 10

PROCESS INSTRUMENTATION AND CONTROL SYSTEM (PICS)

FIELD INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Specification Section covers work related to the various field instruments to be supplied with the Process Instrumentation and Control System (PICS).

B. Field instrumentation, as specified herein, shall be furnished by the same SYSTEM SUPPLIER furnishing services and equipment as outlined in 40 95 00.

1.02 RELATED WORK

A. Specification Section 40 95 00 defines work associated with the overall PICS.

B. Specification Section 40 95 20 defines work associated with the Process Control Panel (PCP) that will interface the system with the field instruments defined hereunder.

1.03 SUBMITTALS

A. Submit the following Field Instrumentation Shop Drawings in a single package:

1. Catalog information, descriptive literature, wiring diagrams, and shop drawings on all components of the field instruments, including all miscellaneous electrical and mechanical devices furnished under this section.

2. Individual data sheets for all components of the field instruments to supplement the above information by citing all specific features for each specific component (e.g. scale range, materials of construction, special options included, etc.). Each component data sheet shall bear the component name and instrument tag number designation shown in the Drawings and Specifications.

3. Installation details for all field mounted devices to show conformance with the Contract Documents.

4. Configuration documentation for all programmable devices to indicate actual settings used to set the device scale, range, trip points, and other control parameters.

5. Proposed tag numbers for each specific instrument.

PART 2 PRODUCTS

2.01 GENERAL

A. All instruments requiring plumbing shall utilize stainless steel components as follows:

1. Test Tap: Shall consist of Crawford Fitting Co. Swagelock quick connects Series QC4-DE, or equal.

2. Tubing, Stainless Steel: Shall be ASTM A 312, TP 316, seamless, soft annealed with 0.065 inch wall. Fittings shall be ASTM A 276, TP 316 compression or socket weld type.

3. Valve, Ball: Shall be stainless steel ball valves, Whitey Series 40, Hoke Flamite Series 7100, or equal.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets or instrument racks.

C. All transmitters located outdoors shall be equipped with aluminum sun-shields.

D. Except where specifically defined otherwise, all transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent. Indicator readouts shall be linear in process units.

2.02 FIELD INSTRUMENTS

A. Bubbler Level System. A Bubbler Level System shall be furnished for each wet well. It shall comprise, as a minimum, the following:

1. A 120 VAC powered compressor.

2. Air line from the compressor to the bottom of the wet well containing the following components, in order from the compressor to the wet well:

a. A low pressure switch.

b. Manual isolation valve.

c. Pressure regulating valve.

d. Needle valve.

e. Pressure Indicating Transmitter.

f. Pressure gauge.

g. Manual isolation valve.

3. All piping, valves and fittings shall be ½ - inch type s16 stainless steel.

B. Pressure Indicating Transmitter. The pressure transducer shall sense variations in pressure and produce a standard current output signal linear with gage pressure.

1. Performance:

a. Built in temperature compensation.

b. Total accuracy of less than or equal to 0.2% of span.

c. Adjustable zero and span values anywhere within the nominal range.

2. Materials:

a. Metallic Wetted parts – 316 Stainless Steel.

b. Fill liquid - NSF approved for use in drinking water applications.

c. Electronics Housing – Plastic (PBT) with conductive coating.

d. Mounting hardware – 316 Stainless Steel.

3. Ratings:

a. Enclosure – IP65

4. Electrical:

a. Transmitter excitation: 12 to 36 Volts DC.

b. Output: 4-20 mA D.C.

5. Options:

a. Provide integral LCD indicator with displayed value in process units.

b. Provide ½ - inch stainless steel impulse piping.

c. Provide local gauge and valves as shown on the Contract Drawings.

d. Provide minimum half inch process connection.

6. Manufacturer, Model series:

a. Wika Model UPT-20 with Model DI-PT-U display unit.

b. Approved equal.

C. Flow Element – Ultrasonic Doppler

1. Type:

a. Strap-on single head sensor

b. Stainless steel mounting clamp

2. Operation:

a. Purpose - To produce a 4-20 mA signal proportional to flow rate.

b. Operating Principle – Transmitted ultrasonic signal is reflected back by suspended solids. The received frequency differs from the transmitted frequency because of the Doppler effect. The difference is proportional to flow rate in the pipe.

3. Functional:

a. Power Requirement - 120 VAC plus or minus 10 percent, 60 Hertz.

b. Maximum Power Consumption – 12 VA

c. Transmitter – Back lit LCD display

4. Physical:

a. Transmitter - NEMA 4X fiberglass enclosure with stainless steel hardware

b. Transducer – Epoxy encapsulated.

5. Performance:

a. Accuracy - Plus or minus 2 percent of full scale between 0.2 and 30 feet per second

b. Capable of operation down to 100 ppm of minimum 100 micron suspended solids.

6. Manufacturers:

a. Dynasonics series D601

b. Approved equal

D. Submerged Pressure Level Measurement System. The level measurement system shall comprise a submerged pressure transducer (Pressure Transmitter, PT), factory attached and sealed interconnecting cable, and junction/termination box with front panel mounted loop-powered indicator (Level Indicator, LI) that indicates the depth of process fluid in the vessel being monitored. Within the pressure transmitter, process pressure variations shall be sensed by a barrier diaphragm and transferred via a non-compressible fill liquid to a Wheatstones Bridge strain gage diffused onto a silicon diaphragm. The electronics within the element shall produce an analog signal proportional to the process pressure.

1. Performance:

a. Static accuracy of the pressure transmitter shall be less than or equal to 0.25% full scale including the combined effects of nonlinearity, hysteresis and non-repeatability, based on a Best Fit Straight Line at 25 degrees C.

b. The pressure transmitter shall be temperature compensated between 0 and 50 degrees C.

c. The shielded and vented interconnecting cable shall be of sufficient length to allow the pressure transmitter to be properly located within the tank, basin, wetwell, etc. being monitored. The cable shall be able to withstand 200 pounds of tensile strength, allowing the transducer to be suspended directly by the cable.

d. The cable shall be equipped with a dessicant filter at the surface end of the vent tube.

e. Transducer shall include 304 stainless steel spacers, nuts, and bolts to protect and keep the diaphragm off the tank floor.

f. Transducer shall be provided with a sealed air bag for compensating for atmospheric changes and to insure that no external moisture reaches the internal electronics.

g. The level indicator shall be loop-powered, backlit and rated for operation at up to 65 degrees C. Provide intrinsically safe model, Precision Digital PD688 or approved equal.

2. Materials:

a. Exterior pressure transmitter parts – 316 Stainless Steel and Viton.

b. Fill liquid - NSF approved for use in drinking water applications.

c. Interconnecting cable jacket – Polyurethane.

d. Terminal junction box – 316 Stainless Steel.

3. Ratings:

a. Terminal junction box – NEMA 4X.

4. Electrical:

a. Transmitter excitation: Loop powered.

5. Manufacturer, Model series:

a. Blue Ribbon Birdcage GP50 Model 311Z.

b. Approved equal.

E. Limit Switch. The limit switch shall detect the closed position of a hatch, door, check valve, etc. by means of an actuator. The actuator shall energize the switch while the door is closed.

1. General:

a. Actuator orientation: As required for application

b. Actuator mechanism: Adjustable lever roller.

c. Switch shall not be mounted on the moving portion of the door, hatch or valve.

2. Materials:

a. Normal applications: Phosphate coated zinc with Epoxy coating.

b. Corrosive locations: All 316 Stainless Steel including actuating lever.

3. Ratings:

a. NEMA 4X for normal applications.

b. NEMA 6 where potential submergence exists.

c. Use explosion proof switches with factory installed cable for all Class I rated locations.

4. Electrical:

a. Normally open and normally closed dry contacts

b. Dry contact rated to 10 Amps at 120 VAC

5. Options

a. Provide stainless steel supports/mounting and strike plates as required.

6. Manufacturer, model:

a. Honeywell, model HDLS or LSX as applicable

b. TopWorks GO model 81

c. Approved equal.

F. Pressure Switch. The pressure switch shall sense pressure variations by means of a 316 stainless steel bourdon tube and operate a hermetically sealed mercury switch when the pressure reaches an adjustable level. Pressure switches shall be equipped with diaphragm seals where shown on the drawings.

1. Performance:

a. Adjustable deadband (7 psig minimum) over 10-100 psig measurement range.

b. Automatic reset.

c. SPDT contacts.

d. Setpoint and deadband adjustments visible from outside the enclosure.

2. Materials:

a. Pressure Chamber Wetted parts – 316 Stainless Steel.

b. Housing – Flanged steel.

3. Ratings:

a. NEMA 4X.

4. Electrical:

a. Contacts rated 4 Amps at 120 V AC.

5. Manufacturer, Model series:

a. Mercoid, DAW-43-153-6E.

b. Approved equal.

2.03 TEST EQUIPMENT AND SPECIAL TOOLS

A. Provide a hand held programmer suitable for calibrating the pressure transmitters.

2.04 SPARES AND EXPENDABLES

A. Provide the following spare parts:

1. One spare analysis sensor of each type used.

2. Ten percent spare fuses (minimum of 10) of each type and rating supplied.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the PICS field instruments in strict accordance with the respective manufacturer's instructions and recommendations, in locations as shown on the Drawings, and as indicated on the installation details of the Drawings.

B. Fully calibrate each instrument.

3.02 TRAINING

A. One 8-hour day of on-site (field) training shall be conducted at the OWNER's plant site and shall provide detailed hands-on instruction to OWNER's personnel covering all supplied field instruments.

B. Training shall include:

1. Calibration procedures.

2. Preventive maintenance methods and timing.

3. Fault-finding techniques.

C. The training shall run at times chosen by the OWNER following installation and check-out of field instrumentation.

END OF SECTION

SECTION 40 95 20

PROCESS INSTRUMENTATION AND CONTROL SYSTEM (PICS)

SYSTEM HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section defines work associated with the control system hardware to be furnished.

B. All equipment defined hereunder shall be furnished in strict compliance with JEA Standards for Wastewater Pump Stations.

C. The SYSTEM SUPPLIER shall design, furnish and install all interior wiring within the control panels and furnish complete wiring diagrams showing the electrical circuits inside the panel and interconnections between the panel and the external instruments and components. These drawings shall utilize JEA standard AutoCAD drawings modified as necessary to reflect the site specific requirements.

D. Extracts from OWNER standards showing panel layouts and required components are provided in Contract Drawings I-04 and I-05.

E. Size control panel(s) to adequately dissipate heat generated by equipment mounted inside or on the panel front face.

PART 2 PRODUCTS

2.01 CONTROL PANEL REQUIREMENTS

A. General:

1. The requirements specified herein are intended to supplement, where necessary, the OWNER standard requirements. Where conflict occurs between these requirements and OWNER standards, the latter shall prevail.
2. All conduit entry shall be from the bottom only. The PCP shall be limited to maximum dimensions of 48 inches in width by 20 inches in depth by 84 inches in height.

3. The panel shall be provided with an isolated copper grounding bus to ground all signal shield connections.
4. The panel shall be equipped with an internal, hand-switch controlled, 40-watt LED light and 120V, 15 amp, duplex utility receptacle. These shall be serviced through a dedicated breaker.
5. The panel shall be protected from internal corrosion by the use of corrosion – inhibiting vapor capsules. The vapor capsules shall be provided by the following:
    a. Northern Instruments Model Zerust VC-6-2
    b. Hoffman, model A-HC15E
    c. Approved equal.
6. All outdoor panels and enclosures containing electronic or electrical components shall be equipped with sunshields on both sides, the back and the top with a minimum separation of one inch and a maximum separation of one and one-half inches. Sun shields shall be 14 gauge Stainless Steel or 12 gauge Anodized Aluminum or thicker. Finish with reflective white, two part epoxy coating or reflective, white, polyester powder deposited coating.
7. All outdoor control panels and enclosures shall be equipped with 3 ½" stainless steel mounting uni-struts across the width of the back. For free-standing panels the struts shall be located half-way up the panel and six inches from the top. For other panels they shall be located 3" from the top and 3" from the bottom.
8. All discrete output signals shall be equipped with interposing relays to electrically isolate them from the control system I/O.

B. Finish:
1. All front panel openings for panel-mounted equipment shall be cut with counter-boring and provided with trim strips as required to give a neat finished appearance.
2. All steel panel surfaces shall be treated with phosphatized treatment inside and out, and then finished on the exterior with two coats of baked enamel of the approved color. Interiors of panels shall be white, ANSI No. 51.

C. Doors:

1. Control panels shall have a continuous piano hinge door for ease of access. A minimum of 80% of the panel interior shall be exposed by doors.
2. The inside of each door shall be equipped with a print pocket.
3. Two-door enclosures shall have a removable center post.

D. Nameplates:

1. All front-face panel mounted controls and indicators shall be equipped with 10-year outdoor-rated adhesive laminated plastic nameplates to completely define their use. Provide Brady Type BBP31 or BBP33 as applicable or approved equal.
2. All internal components shall be equipped with identification tags.
3. All wiring shall be labeled.

E. Power Supplies.

1. Provide a 24 Volts D.C. Power Supply
2. A 24 Volts D.C. Uninterruptible Power Supply (UPS) shall be provided as follows:
    a. Size the UPS for all internal equipment.
    b. Provide 15 minutes battery back-up capability at full load.
    c. Built-in battery charger
    d. Provide Siemens SiTop series, no equal.

F. Electrical:

1. Main circuit breaker and branch circuit breaker for each branch circuit as required to distribute power from the main power feed.
2. All breakers accessible when the panel door is open.
3. No more than 20 devices on any single circuit.
4. No more than 12 amps for any branch circuit.
5. Panel (or site) lighting, receptacles, heaters, controls, telemetry and fans on separate branch circuits.

G. Wiring:

1. Power wiring shall be 300 volt, type THWN stranded copper, No. 14 AWG size, for 120V service.

2. Discrete wiring shall be 300-volt type THWN stranded copper, sized for the current carried, but not smaller than No. 18 AWG.
3. Analog signal wiring shall be 300 volt, stranded copper in twisted pairs, foil-wrapped with braided shield and no smaller than No. 18 AWG. Belden BlueHose.
4. Panel wiring shall be routed within wire troughs or panduits.
5. Hinge wiring shall be secured at each end with the bend portion protected by a plastic sleeve.
6. Analog or dc wiring shall be separated from any ac power or control wiring by at least six inches.
7. Each wire shall be uniquely identified at all terminations using machine printed plastic sleeves.
8. All wiring shall use ferrule terminations.

H. Construction:
1. Minimum metal thickness: 14-gauge.
2. Stiffeners as required to prevent deflection under instrument loading and permit lifting without racking or distortion.
3. When required, removable lifting rings and fill plugs to replace rings after installation.
4. All components and terminals shall be accessible without removing other components except for covers.

I. The panel shall be a manufactured item by Schaeffer or Rittal.

2.02 PANEL DEVICES

A. Selector Switch. Units shall meet the following:
1. Heavy-duty, oil-tight, industrial type selector switches rated for NEMA 4 service.
2. Contacts rated for 120-volt ac service at 10 amperes continuous.
3. Number of positions and contact arrangements as required.
4. Factory-engraved legend plate indicating position definition.
5. Panel mounting accommodating panel thickness between 1/16 to ¼ inch.
6. Black knob type operator.
7. Square D Class 9001, Type K, Allen Bradley 800T Series or approved equal by Siemens.

B. Pushbutton. Units shall meet the following:

1. Heavy-duty, oil-tight, industrial type push buttons rated for NEMA 4 service.
2. Contacts rated for 120-volt ac service at 10 amperes continuous.
3. Number of positions and contact arrangements as required.
4. Factory-engraved legend plate indicating function.
5. Panel mounting accommodating panel thickness between 1/16 to ¼ inch.
6. Operator: Red extended head for STOP, green flush head for START, black flush head for other functions.
7. Square D Class 9001, Type K; Allen-Bradley type 800T, or approved equal by Siemens.

C. Indicating Light. Units shall meet the following:

1. Heavy-duty, oil-tight, push-to-test industrial type with integral transformer for 120V AC application.
2. Rated for NEMA 4 service.
3. Screwed on flat-faced lenses in colors shown on the drawings.
4. Factory-engraved legend plates.
5. Square D type K, Allen-Bradley Type 800T, or approved equal by Siemens.

D. Control/Relays: All relays shall meet the following:

1. Compact, general-purpose, plug-in type.
2. Socket mounted.
3. Contacts rated for not less than 10 amperes at 120V.
4. Equipped with neon status lights and test buttons.
5. Permanent, legible identification.
6. Potter & Brumfield series KRPA or approved equal by Finder.

E. Time Delay Relay. Time delay relays shall meet the following:

1. Available functions: On delay, Off delay, or one shot.
2. Socket mounted.
3. Knob adjustment.
4. Contacts rated for not less than 10 amperes at 120V.
5. Timing range as appropriate for the application.
6. Magnecraft series W211 or approved equal.

2.03 CONTROL SYSTEM PLC HARDWARE

A. The PLC shall comprise a single rack containing Siemens S7 series components. The use of other manufacturer's products will not be acceptable.

B. The rack shall comprise the following modules:

1. Central Processing Unit (CPU) Module. The CPU module shall contain the user program and be equipped with the battery back-up option to protect the program in the event of a power loss. Siemens model S7 315-2 PN/DP, 348K.
2. Input/Output Modules. Furnish I/O modules sufficient to accommodate the hard-wired signals shown on the Contract Drawings plus a minimum of 15% pre-wired spare signals of each type. Use the following modules:
    a. Analog Input Module. Eight, optically isolated analog input channels. Siemens model SM-331.
    b. Discrete Input Module. Sixteen 24 VDC input channels. Siemens model SM-321.
    c. Discrete Output Module. Sixteen 24 VDC outputs. Siemens model SM-322.
3. Communications Processor. The communications processor shall provide an RS-232 connection to the SCADA Panel radio. Provide Siemens Sinaut S7 TIM 3V-1E Advanced, no equal.

C. The rack shall be sized and populated such that all I/O module types shall be grouped together and followed by an open slot for future expansion.

D. All PLC input/output modules shall be fully wired to field wiring termination blocks together with all required surge protection, etc. The initial live signals are listed on the instrumentation drawings. The remaining signals shall be spare for future use. All spare signals shall be equipped with surge protection devices.

E. The Operator Interface Terminal (OIT) shall be a Simatic 15" touch screen. Siemens model TP 1500 Comfort.

F. Ethernet Switch. Provide a minimum eight-port 100 Base TX unmanaged Ethernet switch interconnecting the PLC and OIT. Siemens Scalance, no equal.

2.04 MISCELLANEOUS CONTROL SYSTEM EQUIPMENT

A. The SCADA Panel shall be meet the following:

1. Except where otherwise noted below, the SCADA Panel shall be constructed in accordance with JEA Master Lift Station standards sheet E-20, a copy of which is provided as Contract Drawing I-4.
2. In-coming AC power shall be from a lighting panel and not from the PCP as shown. It shall be equipped with a surge protector as defined under section 40 95 00.
3. An alarm dialer is not required.

2.05 GENERATOR INTERFACE PANEL.

A. The Generator Interface Panel shall be furnished for installation adjacent to the fuel tank monitoring panel. It shall convert the following from hard-wired inputs to Profibus for connection to the PICS:
1. Fuel leak status from the fuel tank monitoring panel.
2. Fuel tank level from the fuel tank monitoring panel.
3. Generator run and fault status from the generator control panel.

B. The panel shall be a NEMA 4X stainless steel enclosure with aluminum sun-shields on top and both sides.

C. Field wiring shall be converted to Profibus within the panel using the following components:

Qty	Part #	Manufacturer	Description
2	6ES7131-4BD00-0AA0	Siemens	Electronic module, 4DI, DC 24V, standard
1	6ES7134-4GB00-0AB0	Siemens	Electronic module, 2AI, I, standard, for 2-wire-MU
1	6ES7138-4CA00-0AA0	Siemens	PM-E DC 24V power module for electronic modules
1	6ES7151-1AA03-0AB0	Siemens	IM 151-1 connecting the ET200S to PROFIBUS DP
5	6ES7193-4CA40-0AA0	Siemens	Universal terminal module; screw connection
1	6ES7193-4CD20-0AA0	Siemens	Terminal module for AUX1 supply; screw connect.
1	PA9D01-42	Molex	Profibus fast connect RS485 connector 90 Deg.
1	DLAW-06D3	Citel	Surge Protection for Profibus
2	1061200000	Weidmuller	End Bracket
1	6ES7972-0DA00-0AA0	Siemens	Active Profibus Terminator Resistor
1	Standard DIN Rail	Standard DIN Rail	for mounting the ET200S

2.06 SPARES AND EXPENDABLES

A. Provide the following spare parts:

1. One of each PLC module including the CPU.
2. One spare DC power supply of each type provided.
3. Five (5) spare relays of each type provided.
4. Five (5) spare surge protection device of each type provided.

B. Provide the following expendables:

1. Twenty Five (25) corrosion inhibitor capsules
2. Ten (10) spare fuses of each type and rating supplied.
3. Ten (10) spare indicator light bulbs of each type and color supplied.

PART 3 EXECUTION

3.01 TRAINING

A. Hardware Maintenance: Provide a minimum of two days of hardware training for up to three of the OWNER's personnel in the maintenance of the PLC hardware which shall include:

1. Training in standard hardware maintenance for the equipment provided.
2. Specific training for the actual hardware configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up.
3. Test, adjustment, and calibration procedures.
4. Troubleshooting and diagnosis.
5. Component removal and replacement.
6. Periodic maintenance.

END OF SECTION

SECTION 41 22 00

CRANES, HOISTS, AND TROLLEYS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the general standards, materials, installation, and testing of motorized and hand-actuated cranes, hoists, and trolleys.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Miscellaneous Structural Steel and Aluminum: 051210.

B. Painting and Coating: 099000.

C. General Electrical Requirements: 260500.

D. Equipment, Piping, Duct, and Valve Identification: 400775.

E. Overhead Traveling Bridge Cranes: 412210.

F. Top Running Single Girder Bridge Cranes: 412212.

G. Underhung Bridge Cranes: 412214.

H. Jib Cranes: 412218.

I. Monorail Systems: 412220.

J. Hand-Operated Hoists and Trolleys: 412230.

K. Top Running Hand-Actuated Bridge Cranes: 412240.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the Section 01 33 00.

B. Submit manufacturer's catalog data and dimensioned drawings for bridge cranes, trolleys, hoists, rails, and controls.

C. Show areas to be coated and type of coating.

D. Submit electrical drawings showing wiring, disconnect switch, terminals, limit switches, and fuses. Label each terminal showing which control or electric power wire connects to each terminal. Submit motor data showing motor horsepower, enclosure, and NEMA design classification.

E. Submit manufacturer's field assembly and installation instructions.

F. Submit calculations showing that runway and trolley stops resist the forces applied.

G. Submit test report describing procedures and results of both shop and field tests.

1.04 MANUFACTURER'S SERVICES

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

A. One labor day to check the installation and advise during start-up, testing, and adjustment of each bridge crane or monorail system in the project.

B. One labor day to instruct the Owner's personnel in the operation and maintenance of each bridge crane or monorail system in the project.

PART 2 - MATERIALS

2.01 STANDARDS, SPECIFICATIONS, AND CODES--MONORAIL AND JIB CRANE SYSTEMS

Design and construction of motorized hoists, trolleys, and monorail systems shall conform to ANSI HST-4-1999 (reaffirmed 2004), ANSI MH27.1, and ASME B30.11.

2.02 STANDARDS, SPECIFICATIONS, AND CODES--TOP RUNNING HAND- OPERATED BRIDGE CRANES

Design and construction of traveling bridge cranes shall conform to CMAA 70 and ASME B30.17.

2.03 STANDARDS, SPECIFICATIONS, AND CODES--UNDERHUNG BRIDGE CRANES

Design and construction of motorized hoists, chain-operated and motor-driven trolleys, and underhung bridge crane system shall conform to ANSI HST-4-1999 (reaffirmed 2004), ANSI MH27.1, and ASME B30.11.

2.04 STANDARDS, SPECIFICATIONS, AND CODES--MOTORIZED HOISTS AND TROLLEYS

Design and construction of motorized hoists shall conform to ANSI HST-4-1999 (reaffirmed 2004).

2.05 STANDARDS, SPECIFICATIONS, AND CODES--HAND-OPERATED HOISTS AND TROLLEYS

Design and construction of hand-operated hoists shall conform to ANSI/ASME HST-2-1999 (reaffirmed 2004).

2.06 MOTORIZED HOISTS

A. Hoists shall be electric, wire-rope type. Hoisting machinery shall consist of a rope drum driven through gear reductions by an electric motor with hoisting rope, sheaves, and

hoist brake. Hoist and trolley shall be a standard package of a single trolley/hoist manufacturer. Provide true vertical lift. Design and construct hoists in accordance with ANSI HST-4-1999 (reaffirmed 2004).

B. Provide drums grooved to 50% (minimum) of the rope diameter to protect against rope pileup. Hoisting rope shall be of plow steel or improved plow steel, flexible, designed and manufactured for crane and hoist service, and complying with ANSI HST-4-1999 (reaffirmed 2004).

C. Provide two brakes for hoist, each brake capable of independently holding the hoist's rated load capacity. One brake shall be a fail-safe electric type, connected to the motor shaft or to a shaft in the hoist gear train. The second brake shall be a mechanical load brake mounted in the gearbox and operating in a continuous oil bath. Both brakes shall operate when power to the motor is shut off or there is a power failure. Hoist brakes shall comply with ANSI HST-4-1999 (reaffirmed 2004).

D. Provide upper and lower adjustable geared limit switch.

E. Design load hook so that it opens slowly before hook failure when the hoist is overloaded. Provide hook latch. Provide gauge marks to show if hook has opened up.

F. Provide hoist block with steel-enclosed housing.

G. Provide mechanical or electrical overload protection to prevent lifting of loads exceeding the rated capacity of the crane.

2.07 MOTORIZED TROLLEYS

A. Trolley frame shall be welded steel, cast steel, or ductile iron.

B. Design wheel and axle system to prevent a drop of more than 1 inch in case of axle failure.

C. Trolley drive shall consist of a drive shaft driven by an electric motor through a gear reduction unit. The trolley drive shall drive the trolley wheels either directly or through another gear reduction at the wheels.

D. Gears shall be of the helical, spur, worm, or herringbone type, made from rolled or cast steel, with machine-cut teeth having a 20-degree pressure angle. Horsepower ratings shall be in accordance with AGMA standards for the service factor associated with the ANSI HST trolley service classification. Gears shall be AGMA Class II service. Gearing shall be oil splash lubricated.

E. Provide trolley brakes designed in accordance with ANSI HST-4-1999 (reaffirmed 2004).

F. Provide mechanical stops and limit switches at both ends of trolley travel.

G. Wheels shall be drop forged or rolled steel with heat-treated treads and flanges or cast iron with chilled tread. Wheels and wheel bearings shall comply with ANSI HST-4-1999 (reaffirmed 2004).

2.08 MOTORS

A. Motors shall be NEMA Design D with high starting torque, low starting current, and high slip at full load.

B. Provide separate motors for bridge, hoist, and trolley drives when motorized units are specified. Provide one motor for hoist. Provide one or two motors for trolley.

C. Motors shall be totally enclosed nonventilated (TENV), with Class B or F insulation and with a temperature rise that does not exceed the insulation class at the duty rating listed in the subsection on "Service Conditions." Provide thermal overload protection either of the thermostatic type in the motor starter or of the relay type in the motor windings. Provide integral motor starters for the bridge, hoist, and trolley motors.

D. Motors shall be single or two speed and have voltage and frequency ratings as specified in the subsection on "Service Conditions." Motor speed shall not exceed 1,800 rpm. Determine the required motor horsepower for the trolley and hoist and bridge per ANSI MH27.1 and ANSI HST-4-1999 (reaffirmed 2004).

2.09 UNDERHUNG BRIDGES

A. The crane shall be a single girder, underhung bridge crane. The bridge shall be center motor or dual motor drive. Construct bridge structure of wide-flange girders, specially rolled or fabricated steel sections, or standard I-beams fabricated from structural steel shapes. Material of construction shall conform to ASTM A36.

B. Construct end trucks of steel channel weldments joined and reinforced at each end by steel "U" plates and further reinforced by steel plates at wheel bearing points. Design bridge end trucks in accordance with the ANSI MH27.1. Provide end trucks with impact absorbing bumpers. Attach runway stops to resist the force applied when contacted. Locate runway stops at the limits of travel of the bridge. Runway stops shall not engage the wheels.

C. Bridge drive shall be by means of a manually operated endless chain. Chain pull shall not exceed 40 pounds.

D. Provide limit switches at both ends of the bridge travel.

E. Horsepower ratings shall be in accordance with AGMA standards for the bridge service rating, per the CMMA specifications. Gears shall comply with AGMA Class II service. Gearing shall be oil-splash lubricated.

F. Gears shall be of the helical, spur, or herringbone type, made from rolled or cast steel, with machine-cut teeth with a 20-degree pressure angle.

G. Gear reduction at the wheels may be used for fixed axle drive. Gear reduction at wheels shall be either oil or grease lubricated.

H. Provide alloy steel wheel axles, machined and ground to receive inner bearing races. When rotating axles are used, mount the wheels on axles with a press fit and keys or with keys alone.

I. Bearing shall be combination radial and thrust type, consisting of either double-row angular contact ball bearings or single-row tapered roller bearings. Bearings shall be lifetime lubricated and sealed or fitted with ZERK fittings for pressure lubrication.

2.10 CONTROLS

A. Bridge, trolley, and hoist controls shall be by a floor-operated push-button pendant station.

B. Push-Button Pendant Station: Provide momentary contact push buttons. Mount controls in a NEMA 4 enclosure. For direct-hung pendants, provide an offset swing arm. Provide cable lengths such that floating pendants hang 36 inches off the floor and direct-hung pendants hang 12 inches off the floor.

2.11 FACTORY TESTING OF MOTORIZED BRIDGE CRANES

Test cranes having motorized bridges at the factory. Assemble the crane at the factory. Provide no-load manufacturer-certified, nonwitnessed running tests of the bridge and trolley. Perform running tests with the pendant control that will operate the crane in service.

PART 3 - EXECUTION

3.01 LABELING AND MARKING

A. Provide labels and marking per Section 400775. Provide capacity plates on each side of the trolley/hoist and on bridge. Plates shall be legible from the floor.

B. Provide tags on each piece of equipment requiring lubrication. Tag shall state the following information:

1. Manufacturer's recommended lubricant, by brand name and number or code.

2. Frequency of lubrication.

3. Provide removable paper date calendar on which maintenance personnel can fill in dates of lubrication. Enclose calendar in a plastic shield. Attach calendar to equipment by means of a stainless steel or brass chain.

3.02 LUBRICATION

Provide the manufacturer's recommended lubricants for motors, gears, and other equipment.

3.03 PAINTING AND COATING

Coat track, bridge, trolley, hoist, gear reducer enclosures, and motors per Section 099000. Apply prime coat at factory. Color of finish coat shall be OSHA Safety Yellow

3.04 TEST LOAD BLOCK

The test loads used in the field testing shall be the property of the Owner upon successful completion of the field testing. Place the test loads at the location on the site directed by the Owner. Provide labels on the test loads describing the equipment for which the loads are to be used, tag number, and weight of the loads.

3.05 FIELD PERFORMANCE TESTING FOR ELECTRICALLY POWERED CRANES, HOISTS, AND TROLLEYS

Perform a no-load test and a load test on each crane or monorail system in the presence of the Owner's Representative as follows:

A. No-Load Test:

1. Raise empty block to within about 2 feet of its upper position and stop.

2. Raise empty block until the upper limit trips and stops the hoisting motion. Assure that limit switch trips at the specified setting.

3. Adjust upper limit switch if necessary. Repeat Steps a and b.

4. Lower the block to about 2 feet above its lower position and stop.

5. Lower empty block until the lower limit switch trips and stops the lowering motion. Assure that limit switch trips at the specified setting.

6. Adjust lower limit switch if necessary. Repeat Steps d and e.

7. Do not lower the block beyond the point at which two wraps remain at each end of the drum.

8. Move the trolley.

B. Trolley Test:

1. Move the trolley to within about 2 feet of its farthest left limit switch position and stop.

2. Move the trolley to the left until the limit switch trips and stops the trolley motion. Assure that limit switch trips at the specified setting.

3. Adjust limit switch if necessary. Repeat Steps a and b.

4. Repeat Steps a, b, and c for the right limit switch.

C. Load Test: After the no-load test has been completed, test the system with loads in the following manner:

1. Raise a load equal to 50% of the rated load no higher than required to clear its supports and stop. Adjust brakes if necessary. Raise load about 3 feet above its supports and stop. Lower load about 12 inches and stop. Check drift of load

during stopping. If load drifts, brakes are not in proper adjustment and shall be corrected. Repeat this operation until proper adjustment of the brakes is obtained. Lower load carefully back to its supports.

2. Follow the same procedure as indicated in Step a above except with a 125% test load; then hoist the load high enough to clear all obstructions. Move trolley across the entire span of bridge or length of track. Transport the test load by means of the bridge or monorail for full length of the runway in one direction with the trolley at one extreme end of the crane and in the other direction with the trolley at the extreme opposite end of the crane. Lower load carefully onto its supports.

D. Crane or monorail system shall run smoothly, with no binding, stopping, or sticking. Adjust and realign equipment and retest if binding, stopping, or sticking occurs. Motors shall not be overloaded.

3.06 FIELD PERFORMANCE TESTING FOR MANUALLY OPERATED CRANES, HOISTS, AND TROLLEYS

Perform a no-load test and a load test on each crane in the presence of the Owner's Representative as follows:

A. No-Load Test:

1. Raise empty block to within about 2 feet of its upper position and stop.

2. Raise empty block to its maximum lift.

3. Lower the block to about 2 feet above its lower position and stop.

4. Do not lower the block beyond the point at which one wrap remains at each end of the drum.

5. Move the trolley.

B. Trolley Test: Move the trolley to within about 2 feet of its farthest left position and stop.

C. Load Test: After the no-load test and trolley test have been completed, test the crane with loads in the following manner.

1. Raise a load equal to 50% of the rated load no higher than required to clear its supports and stop. Adjust brakes if necessary. Raise load about 3 feet above its supports and stop. Lower load about 12 inches and stop. Check drift of load during stopping. If load drifts, brakes are not in proper adjustment and shall be corrected. Repeat this operation until proper adjustment of the brakes is obtained. Lower load carefully back to its supports.

2. Follow the same procedure as indicated in Step a above except with a 125% test load; then hoist the load high enough to clear all obstructions. Move trolley across the entire span of bridge. Transport the test load by means of the bridge for the full length of the runway in one direction with the trolley at one extreme end of the

crane and in the other direction with the trolley at the extreme opposite end of the crane. Lower load carefully onto its supports.

D. System shall run smoothly, with no binding, stopping, or sticking. Adjust and realign equipment and retest if binding, stopping, or sticking occurs.

END OF SECTION

SECTION 43 21 40

FLOODED SUCTION SOLIDS HANDLING

PUMPSPART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of raw wastewater pumps designed to operate in a dry well under both dry and submerged conditions.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 09 90 00.

B. Variable Frequency Motor Controllers: 26 29 23.

C. Equipment, Piping, Duct, and Valve Identification: 40 07 75.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Submittals 01 33 00.

B. Submit dimensional drawings.

C. Submit manufacturer's catalog data and detail drawings showing all pump parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings. Show outline dimensions and weights of pumps, bases, and motors. Identify each pump by tag number to which the catalog data and detail sheets pertain.

D. Submit pump curves from manufacturer's catalog data on which the specified operating points are marked. Show efficiency, brake horsepower, and NPSH required for the selected pump curve for each specified operating point. Show maximum operating speed.

E. Show impeller diameter, eye area, sphere size, and number of vanes.

F. Submit setting drawings. Show anchor bolt layout and anchor bolt dimensions.

G. Submit manufacturer's reports on hydrostatic tests and performance tests.

H. Submit manufacturer's sample form for reporting the performance test results. Submit at least two weeks before the tests. The test form shall contain the data presented in the sample form in Section 6 of ASME PTC 8.2 or ANSI/HI 1.6.

I. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show flow, pump total head, brake horsepower, pump efficiency. Provide copies of the data recorded during test and methods of data reduction for determining certified test results.

1.04 DEFINITIONS

Terms shall be as defined in ANSI/HI 11.6-2001 and ASME PTC 8.2. If there is a discrepancy in definitions between the two publications, the definitions given in ANSI/HI 11.6-2001 shall govern.

1.05 MANUFACTURER'S SERVICES

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

A. One labor day for each service listed in the subsection on “Service Conditions” to check the installation and advise during start-up, testing, and adjustment of the pumps.

B. One labor day to instruct the Owner's personnel in the operation and maintenance of the pumps.

PART 2 - MATERIALS

2.01 PUMP DESIGN

A. The Contractor shall assign unit responsibility to the pump supplier for the complete pump system, including motors and cooling system control assembly.

B. Each pump shall be of the vertical, nonclog, single-suction, centrifugal type and shall be suitable for pumping unscreened raw sewage.

C. The pump, with its appurtenances and electric cable, shall be capable of continuous submergence under water without loss of watertight integrity to a minimum depth of 65 feet.

D. Design the casing to withstand a hydrostatic test of at least 150% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff.

E. Each pump shall be capable of at least a 10% head increase at normal operating conditions by installing a larger impeller or an impeller of different hydraulic design.

F. Pump curve shall be continuously rising and shall be free of dips and valleys from the design point to the shutoff head. The shutoff head shall be at least 110% of the head that occurs at the design point.

G. The NPSH required shall be at least 10 feet less than the minimum NPSH available at all points on the pump curve up to 120% of the flow at the BEP.

H. Design the pump and its components to operate continuously over a flow range of 70% to 120% of the flow at the BEP.

2.02 SUCTION AND DISCHARGE CONNECTIONS

A. Suction and discharge connections shall be flanged, ASME B16.1, Class 125. Flanges shall be flat faced. Bolt holes shall straddle the horizontal and vertical centerlines.

B. Provide 90-degree suction elbow with cleanout. The inner contour of the handhole cover shall conform to that of the elbow. Provide a 1/2-inch pipe tap near the suction flange for a gauge connection. Tap the suction elbow for a 1-inch drain connection. Provide gasket between elbow and pump inlet. Cap screws or bolts connecting the suction elbow to the casing shall be Type 316 stainless steel, ASTM A276. Gasket material shall be cloth-inserted rubber or neoprene, 1/8-inch thick.

C. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by no less than two stainless steel guide bars or stainless steel guide wire pressed tightly against the discharge connection elbow. No portion of pump shall bear directly on the floor of the sump.

2.03 PUMP BASES (DRY WELL INSTALLATION)

A. Each pump base may be of cast iron or fabricated steel construction. The base shall provide openings large enough to permit access to the suction elbow and cleanout handhole. Design the pump base to support the assembled weight of pump. The base

shall safely withstand all stresses imposed thereon by vibration, shock, and all possible direct and eccentric loads.

B. The pump base shall be of adequate horizontal dimensions to provide sufficient footing contact area and anchorage facilities. The height of the pump base shall be such that the suction base elbow will clear the floor or footing surfaces.

2.04 POWER SUPPLY

Power supply will be 480 volts, 60 hertz, 3 phase.

2.05 VIBRATION AND RESIDUAL UNBALANCE

A. The maximum vibration level shall not exceed that shown in Figure 11.6.16B in ANSI/HI 11.6-2001.

B. Maximum residual unbalance in impellers shall not exceed that shown in Figure 9.6.4.15B in ANSI/HI 9.6.4 a balance quality grade of G2.5 per ISO Standard 1940/1.

2.06 VOLUTE CASING

Volute casing shall be of a single piece, nonconcentric design with smooth fluid passages at all points to pass any size solids which can pass through the impeller. Casing shall be accurately machined to fit the mechanical seal and suction cover assemblies. Fit the bottom of the volute with a Type 316 or 420 stainless steel or rubber-lined carbon steel replacement wear ring. The volute shall have a tangential discharge nozzle. Provide a 3/4-inch drain with plug in the volute.

2.07 IMPELLER

A. Impeller shall be enclosed type. Each impeller shall be cast in one piece and shall be statically and dynamically balanced, double-shrouded thrulet with smooth water passage to prevent clogging by stringy or fibrous materials and other matter found in normal raw wastewater applications.

B. Each impeller shall be keyed to the shaft, and the fastening of the impeller to the shaft shall be made by a locking device. The locking device shall be sealed from the liquid by means of an O-ring and covered and secured to the end face of the shaft by a single bolt.

C. Fit each impeller with a replaceable wear rings to provide sealing between the volute and impeller.

2.08 SHAFTS

A. Pump shaft diameter shall be such that it will not deflect more than 0.002-inch at the mechanical seal face with the largest impeller installed while operating at the maximum pump speed. Tolerance on the shaft diameter shall not exceed 0.002 inch. Dynamic shaft deflection at the stuffing box face shall not exceed 0.002 inch.

B. The first lateral critical speed of the rotating assembly shall be at least 120% of the maximum pump operating speed.

C. Surface finish of the shafts or sleeves through the mechanical seal and at the rubbing contact-bearing housing seals shall not exceed a roughness of 32 microinches.

D. If a carbon steel shaft is used, provide Type 420 stainless steel shaft sleeves having a minimum hardness of 450 Brinell.

2.09 PUMP SEAL

A. Provide each pump with Chesterton single split mechanical seal with SpiralTrac Environmental Controller.

B. Provide each pump with a tandem mechanical shaft seal system. The upper 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 or cast chromium ring and one positively driven rotating carbon ring functioning as an independent secondary barrier between the pumped liquid and the stator housing. The lower of the tandem set of seals shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring, both of which shall be tungsten carbide.

C. Each interface shall be held in contact by its own spring system supplemented by external liquid pressures. The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable.

D. Shaft seals without positively driven rotating members or conventional double mechanical seals with a common single or double spring acting between the upper and lower units requiring a substantial pressure differential to offset external pressure and

effect sealing shall not be considered acceptable or equal to the dual independent seal system specified.

E. The shaft sealing system shall be capable of operating submerged to depths of or pressures equivalent to a minimum of 65 feet. No seal damage shall result from operating the pumping unit out of its liquid environment. The seal system shall not rely upon the pumped media for lubrication.

2.10 OIL CHAMBER

Provide each pump with an oil chamber for the shaft sealing system. Design the oil chamber to assure that air is left in the oil chamber to absorb the expansion of the oil due to temperature variations. The drain and inspection plug, with positive anti-leak seal, shall be easily accessible from the outside.

2.11 BEARINGS

A. Each pump shaft shall rotate on two permanently lubricated bearings. The upper bearing, providing for radial thrust, shall be a single row, roller bearing. The lower bearing shall consist of one double row or two single row angular contact bearing(s) for combined axial and radial loads.

B. Pump bearings shall be of the antifriction type designed to give 40,000 hours minimum life by L-10 calculations at maximum speed and operating load in continuous operation.

2.12 CABLE ENTRY

Each cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry system shall utilize one of the two designs specified below.

A. The cable entry junction chamber and motor shall be separated by two terminal boards, which shall isolate the motor interior from foreign material gaining access through the pump top. Both the terminal boards shall be bolted to the interior of the motor housing and sealed by O-rings.

B. Provide cast-iron, pressure-tight cable entry gland, which shall be sealed by a nitrile rubber ring and compression gland. Design the compression gland to conform to the allowable bending radius of the power cable. In addition, cast each individual conductor wire in resin in such a manner to avoid any water leakage into the motor through capillary action, because of external cable damage or other causes.

2.13 MATING SURFACES

A. Machine and fit mating surfaces of major parts with nitrile O-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces, without the requirement of a specific torque limit. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate or equal.

B. Tolerances of parts shall be such that they allow replacement of any part without additional machining required to ensure sealing as described above. No secondary sealing compounds, greases, or other devices shall be used.

2.14 COOLING SYSTEM

A. The motor cooling system shall consist of ambient cooling by radiation and convection to the surrounding space and conduction through the pump volute to the pumped fluid.

B. Pumps equipped with water-cooling system consisting of a water jacket are also acceptable. The water-cooling jacket system shall encircle the stator housing. Provide the water jacket with a separate circulation of the pumped liquid. Cooling water shall enter the cooling jacket by way of the pumping vanes, integral with the impeller design, and exit with the pumping media. Cooling media channels and ports shall be nonclogging by virtue of their dimensions. Provide a separate, clear, external water source for motor cooling as well as lower seal flushing. Alternatively, ambient cooling of the motor may be utilized.

C. Pumps equipped with integral cooling consisting of a pumped ethylene-glycol coolant circulated by means of an impeller on the pump shaft are also acceptable. Provide a cooling jacket and internal pump impeller to circulate the coolant to cool the pump by conduction through the pump volute to the pumped fluid and by radiation and

convection to the surrounding space. Alternatively, ambient cooling of the motor may be used when the pump size and duty permits.

2.15 ELECTRIC MOTORS

A. Each pump shall be driven by a vertical, submersible squirrel cage induction motor, shell type design, housed in an 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°C, 40°C ambient plus 115°C rise, and designed for continuous duty, capable of sustaining a minimum of 10 starts per hour.

B. The stator shall be dipped and baked three times in Class F varnish and shall be shrink-fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall be rejected.

C. The motor shall be sized to be nonoverloading when the pump is operated at any point on the pump performance characteristic curve drawn through the design point and shall have a minimum service factor of 1.10. Motor service factor shall not be used in satisfying pumping requirement.

D. Equip the stator with three sensors or thermistors embedded in the end coils of the stator winding to monitor stator temperature. Provide one sensor or thermistor in each stator phase, to switch off the unit if a winding temperature of 285°F is exceeded.

E. If the pump manufacturer uses thermistors in the motor windings, the pump manufacturer shall provide the motor winding thermistor relay and any motor bearing thermistor relays and shall arrange for their installation in the pump motor starter. Both relays shall operate in a 120-volt control circuit and have contacts as shown in the electrical drawings. Adjust and arrange relays to properly respond to the thermistors mounted within the pump-motor housing.

F. Each pump motor shall have a sensor system to monitor moisture in the stator cavity and temperature sensors within the motor stator windings. Provide a supervision relay for installation in the pump motor starter to trip an alarm if moisture content indicates a failure of the outer mechanical seal or if high temperature is detected in the stator. Supervision relay system shall be Flygt MiniCAS II or equal.

G. Connect sensors and thermistor relays to the pump motor starter in such a manner that their signal can actuate an alarm or provide for immediate shutdown or both.

H. Dry well pump motors shall have a Factory Mutual rating of explosion proof.

2.16 MOTOR CABLES

Pump motor power cables installed shall be made of a Hypalon or Protolon synthetic rubber-jacketed, Type SPC multiconductor cable, suitable for submersible pump applications and heavy mechanical stresses. The power cable shall also be sized according to NEC and ICEA standards and also meet with P-MSHA approval or equivalent. Use a separate Hypalon or Protolon synthetic rubber-jacketed, Type SPC cable for temperature and moisture pilot protection signals. The total length of each cable shall be a minimum of 50 feet.

2.17 MATERIALS OF CONSTRUCTION

A. Materials of construction shall be as listed below:

Component	Material	Specification
Casing, volute, suction and discharge elbows	Cast iron	ASTM A48, Class 30 (minimum)
Impeller	Cast Iron	
	Ductile Iron	
Shaft	Stainless steel	Type 316
	Carbon steel	ASTM A108, Grade C1140, C1141, or C1145; with a Type 420 stainless steel shaft sleeve
Drain and vent plugs	Malleable iron	ASTM A197
Cap screws, bolts, and nuts	Stainless steel	AISI Type 316
Any bronze components in contact with water		See paragraph C below

B. Do not construct the impeller wear ring and case wear ring of the same material. Impeller and bowl wear ring materials shall have a minimum Brinell hardness difference of 50 unless both the stationary and the rotating wear surfaces have Brinell hardness numbers of at least 50.

C. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

2.18 ANCHOR BOLTS, NUTS, AND WASHERS

A. Anchor bolts, nuts, and washers for pumps installed in dry wells shall be stainless steel per Section 05 05 20.

B. Anchor bolts, nuts, and washers for pumps installed in wet wells shall be stainless steel per Section 05 05 20.

2.19 SPARE PARTS

A. Provide the following spare parts for each model or size of pump:

Quantity	Description
1	Set of wear rings for impeller and volute
1	Complete set of seals, primary and secondary
2	Sets of radial bearings
2	Sets of thrust bearings
1	Complete set of O-rings or gaskets, whichever applies to the supplied pump unit

B. Pack spare parts in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained within.

PART 3 - EXECUTION

3.01 SERVICE CONDITIONS

A. Pump hydraulic performance conditions and design data shall be as shown below.

B. Pump Tag Numbers: 1, 2, and 3

Location	Dry Well
Liquid pumped	Domestic Wastewater
Service	Indoors environmental temperature range

	of 20°F to 100°F
Altitude	5 feet above mean sea level
Relative humidity	35% to 95%

Fluid temperature range	50°F to 90°F

Pump Data

Capacity (gpm)	**Pump Total Head (feet)**	**Minimum Pump Efficiency (%)**
1925	57	71
2,500*	49	78
3300	34	68
*Design point.		

Maximum pump speed	900 rpm

Motor horsepower (minimum)	50
Variable speed drive required per Section 262923	Yes
Suction elbow size	8 inches
Discharge nozzle size	8 inches

Manufacturers and models	Fairbanks Morse Model 8x8 C5415 Worthington Model 8MF18B FR6A Allis Chalmers Model 250 8X8X17SC

C. The specified impeller shall be capable of passing a 3-inch solid.

3.02 FACTORY PERFORMANCE TESTING

A. Each pumping unit shall be subjected to a nonwitnessed laboratory performance test. Conduct tests in accordance with the ASME PTC 8.2 or ANSI/HI 1.6, using the actual job driver. The performance test shall be equivalent to Level "A" per ANSI/HI 1.6.

B. No motor overload above nameplate rating will be allowed at any flow up to 120% of the flow at the BEP.

C. Perform an NPSHR test on one pump of each size or model specified.

D. Deviations and fluctuations of test readings shall conform to ASME PTC 8.2, 1.11 (Type A), or ANSI/HI 1.6, paragraph 1.6.5.4.2.

E. Measure flow by the "Capacity Measurement by Weight," the "Capacity Measurement by Volume," or the "Capacity Measurement by Venturi Meter, Nozzle, or Thin Plate Orifice" methods in ASME PTC 8.2 or ANSI/HI 1.6.

F. For pumps in variable speed service, conduct a test on one pump of each size at each operating speed necessary to attain the design points described in the subsection on “Service Conditions.”

G. Perform tests and record data, including head, flow rate, speed, and power, at a minimum of seven points. These points shall include shutoff, minimum flow, midway between minimum flow and design flow, design flow, 120% of design flow, and maximum flow.

H. Perform a hydrostatic test on pump pressure-containing components per ANSI/HI 1.6, paragraph 1.6.4.

3.03 PAINTING AND COATING

A. Coat pump and motor systems installed in dry wells in accordance with Section 099000. Apply the specified prime and intermediate and finish coats at the place of manufacture. Apply finish coats in field. Finish coat shall match the colors specified in the JEA paint specifications.

B. Coat submerged or immersed pumps and motors as required by manufacturer. Apply the specified coatings at the place of manufacture.

C. Line volute and interior wetted surfaces and coat impeller as required by manufacturer.

3.04 SHIPMENT AND STORAGE

A. Prepare equipment for shipment including blocking of the rotor when necessary. Identify blocked rotors by means of corrosion-resistant tags attached with stainless steel wire. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

B. Identify the equipment with item and serial numbers and project equipment tag numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number and project equipment tag numbers of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

C. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

D. Store and protect pumps per API 686 (first edition), Chapter 3, paragraphs 1.4 through 1.9, 1.15, 1.16, 1.20, and 1.21 and as described below.

E. Coat exterior machined surfaces with a rust preventative.

F. The interior of the equipment shall be clean and free from scale, welding spatter, and foreign objects.

G. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of pump

manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

H. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of pump manufacture prior to shipping.

I. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

J. When a spare rotor is specified, prepare the rotor for unheated indoor storage for a period of at least three years. Treat the rotor with a rust preventative and house in a vapor-barrier envelope with a slow-release vapor-phase inhibitor. Do not support the rotor at journals.

K. Wrap exposed shafts and shaft couplings with waterproof, moldable waxed cloth or volatile-corrosion-inhibitor paper. Seal the seams with oil-proof adhesive tape.

L. If electric motors are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer’s recommended procedures for extended storage. Provide temporary covers over the motor electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Inspect electrical contacts before start-up.

3.05 INSTALLING TENSIONING SYSTEM

A. Attach cable bracket to the lip of the equipment opening. Use cast-in stainless steel bolts.

B. Attach the flange discharge elbow to the floor of the wet well using cast-in stainless steel anchor bolts.

C. Install the guide cable/rail per manufacturer's recommendations.

D. Provide and attach the stainless steel lift chain or cable.

3.06 FIELD TESTING

A. Bump motor to ensure that motor has been connected for proper rotation.

B. Perform field tests for 48 hours on each pump. Measure flows at the following head points:

1. Tag Numbers:
2. Location:
3. Service:
4. Maximum rpm:
5. Test Points (Feet):

C. If the measured flows at the above-tabulated pump heads are more than 5% below the flows obtained on the laboratory or factory test, adjust the impellers or provide new impellers or otherwise repair or replace the pumps or calibrate meters or pressure gauges.

D. Conduct vibration-level tests with pumps operating at their rated capacity. Adjust or replace pumps that exceed the maximum vibration levels if requested by JEA.

E. Operate each pump one at a time. Manually adjust the speed for each pump (one at a time) via the respective speed control unit such that the pump output is 30%, 40%, 50%, 60%, 80%, and 100% of the maximum capacity specified. The duration at each flow rate shall be at least one hour.

F. Assure that in the automatic mode each pump responds to its signal. Assure that each pump operates at a steady rate (±5% of set point) at any given flow for 30%, 40%, 50%, 60%, 80%, and 100% of the maximum capacity specified.

G. Assure that limit switches on the pumps' check valves indicate and transmit the signals for the valves in the open and closed positions.

H. Demonstrate that the pumping units, motors, and control system meet the following requirements:

1. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.
2. Automatic and manual controls function in accordance with the specified requirements.
3. Drive equipment operates without being overloaded.

END OF SECTION

SECTION 43 21 88

EMERGENCY DIESEL PUMP ENGINES

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish, install and test a complete, self-contained, automatic standby emergency pump engine system as specified herein. The self-contained emergency pump engine system shall consist of a pump and engine unit, which upon interruption of normal power from MCC or high float level, will provide the required pumping capacity for the station. Diesel engine driven pump sets shall be of the latest commercial type and design with all necessary controls. Contractor shall furnish and install fuel tank, enclosure, engine foundation and fuel tank foundation and all accessories necessary for a complete and operable installation. The enclosure shall be weatherproof, constructed with 5000 marine grade aluminum. All materials shall be new unless specifically called for otherwise. Under this purchase order number or contract number, JEA and the contractor shall be entitled to the special rates and purchase price of equipment and services. The contractor (not JEA) shall pay all cost associated with the installation of the emergency backup pump engine system.

1.02 SHOP DRAWING SUBMITTALS AND ADDITIONAL SUBMITTALS

The Contractor shall be required to submit a complete shop drawing submittal, signed and sealed by a Florida Registered Professional Engineer.

A. Five hard copies, plus the number of copies the Contractor wishes returned as well as three electronic copies, shall be submitted to the Engineer for approval.

B. List of five or more operating installations using major components of the same or similar type equipment furnished for this project.

C. Name and address in Jacksonville of permanent parts supply from which parts may be obtained in sufficient quantity on a 24 hour basis.

D. Shop drawings of the pump engine set, complete power and control wiring diagrams, foundation requirements, auxiliary equipment required including tanks, switches, controls, weatherproof enclosure, breaker, wiring and accessories shall

be submitted.

E. Manufacturer's product data describing unit, auxiliary equipment required, including switches, engine, and pump. Include the following:

1. Specifications for fuel
2. Make of engine
3. Number of cylinders
4. Compression ratio
5. Bore, inches
6. Stroke, inches
7. Piston displacement, cubic inches
8. Piston speed at rated RPM, feet per minute
9. Make and type of pump
10. Pump rating

F. Two complete sets of operating and maintenance manuals shall be supplied for the pump/engine set and for auxiliary equipment.

G. Manufacturer's warranty.

1.03 RATING

Pump Engine set shall be capable of producing rated output for continuous duty at rated engine pump RPM when equipped with necessary operating accessories such as air cleaners, lubricating oil pump, fuel transfer pump, radiator fan, and jacket water pump. Unit shall be sized to pump 6,000 GPM @ 60 TDH. Responsibility for sizing pump engine shall lie with the pump engine supplier and Engineer.

1.04 QUALITY ASSURANCE

A. Unit shall be the product of a firm regularly engaged in the manufacture of diesel engines and pumps, and a standard model in regular production at the manufacturer's place of business. Both engine and pumps shall be warranted by the same manufacturer to establish single source responsibility.

B. Only current units which can be properly maintained and serviced without the necessity of JEA carrying extensive parts stock, or being subject to long periods of interrupted service due to unavailable parts will be considered. Pump-Engine

supplier shall maintain a local parts and service facility. Service facility shall have no less than 80 percent of all engine replacement parts in its stock at all times.

1.05 WARRANTY AND SERVICE CONTRACT

A. Pump – Engine Manufacturer Warranty:

Equipment furnished under this section shall be guaranteed against defective parts and workmanship under terms of the manufacturer's and dealer's standard warranty for 5 year from date of acceptance of the system and shall include labor travel time for necessary repairs and supply of a complementary pump/engine set at the job site for duration of the repairs. Running hours shall not be a limiting factor for the system warranty.

B. Contractor Warranty:

The Contractor shall supply to JEA a two (2) year unconditional warranty after substantial project completion or project acceptance or any other design portion thereof. The warranty shall include materials and installation and shall constitute complete replacement and delivery to the site of materials and installation of same to replace defective materials or defective workmanship with new materials/workmanship conforming to the specifications.

C. The manufacturer shall provide the services of a factory-trained service representative to verify the correctness of the Contractor completed installation; to check all electronic circuitry and mechanical components to assure their proper function; to make all necessary measurements in and around the engine and pump. A minimum of 2 days startup services shall be provided. The manufacturer shall provide through the Contractor to JEA a written certification that the installation is complete, correct and properly calibrated; by written notation for the pump engine certification and the Contractor shall endorse its accuracy.

PART II DIESEL ENGINE

A. Diesel engine shall be vertical or "V" multi-cylinder, full diesel, mechanical injection, heavyduty type with non-Electronic Control Module (ECM), arranged for direct connection to a pump engine, and shall be the product of a manufacturer

regularly engaged in the building of full diesel engines. Engine shall be a current model which has been in regular production for at least three years. Engine shall develop sufficient brake horsepower, net rated RPM, corrected to sea level barometric pressure (29.92 in. HG) and 110 degrees F, to operate pump continuously at its rated output with all losses included without undue heating, vibration or wear. Diesel engine shall be water cooled four cycle compression ignition diesel. The engine exhaust manifold shall have an expanded metal guard spread sufficiently away from
hot parts. Engine shall meet specifications when operating on off road ultra-low sulfur diesel

B. Engine shall be equipped with a pressure lubrication system supplying oil to all surfaces
requiring lubrication. Circulation shall be by a positive displacement pump. Lubrication
system shall include a full flow strainer, oil filter, and an oil cooler of sufficient capacity to
properly cool all lubrication oil circulated.

C. Engine shall have an individual mechanical injection pump and injection valve for each cylinder. Injection pumps and injection valves shall not require adjustment in service. Fuel injection pumps shall be positive action, constant-stroke pumps, actuated by a cam driven by gears from the engine crankshaft. All injection pumps and valves shall be serviced by Engine Manufacturer certified personnel.

1. Fuel lines between injection pump and valves shall be heavy 316 SS seamless tubing; and, to eliminate irregularity of fuel injections, shall be of the same length for all cylinders.
2. Fuel system shall be equipped with replaceable fuel filter elements, which may be easily removed without breaking any fuel line connections or disturbing the fuel pumps or another part of the engine. Provide easily serviceable and replaceable fuel/water separator/filter ahead of other fuel filters.
3. All fuel filters shall be conveniently located in one accessible housing, ahead of injection pumps so that fuel will have been thoroughly filtered before it reaches the pumps. No screens or filters requiring cleaning or

replacement shall be used in injection pump or injection valve assemblies.

4. Engine shall be equipped with a built-in gear-type engine-driven fuel transfer pump, capable of lifting fuel against a head of twelve feet, for supplying fuel through filters to injection pump at constant pressure.

D. Engine shall be provided with suitable safety controls to automatically stop the unit when low oil pressure, water temperature or engine speed exceeds safe limits. Pilot lights shall be provided to visually indicate the cause of engine shut down. Pilot lights shall operate off battery circuit and shall be on pump-engine control panel. Provide contacts for remote engine failure annunciation.

E. Engine shall be equipped with a bronze glow(dipped) coated aluminum radiator and blower fan of sufficient capacity for cooling engine when diesel set is delivering full rated speed an ambient temperature of 125 degrees F. Air flow restriction from radiator shall not exceed 0.5 inches H20. Engine shall have a thermostat integral with jacket water circuit to maintain water at proper operating temperature. The radiator tank can be plastic. Engine shall have a belt driven centrifugal type water pump for circulating water through cooling system.

F. Provide a critical grade type exhaust silencer, manufactured of 316 stainless steel as specified in this specification.

G. Engine shall be provided with an antifreeze solution of 50 percent ethylene glycol, and suitable unit mounted, thermal circulation type water heater incorporating a thermostatic switch to maintain engine jacket water at 90 degrees F. in an ambient temperature of 30 degrees F. Heater shall be 1000 watts minimum, single phase, 60 Hertz, and applicable voltage. Jacket Water Heater Hoses shall be reinforced rubber heater hose type or better with ball valves to isolate hose in the event that the hoses or JWH needs replacing.

H. Furnish a set of spare parts and tools regularly supplied with engine. Include all tools of a special nature required to properly service engine.

I. Provide one or more engine mounted dry type air cleaners of sufficient capacity to protect working parts of the engine from dust and grit.

J. Engine shall be equipped with an oil/ vapor recovery container or box that meets EPA regulations. The intent of the recovery system is so the blow by waste will not escape into the atmosphere or soak the radiator coils, as well as be a possible housekeeping issue around the engine-generator.

K. All engine exhaust emissions shall meet EPA requirements for standby power generation.

L. Engine starting system shall include an electric motor start system of not less than 24 volts, including dc starting motor, required voltage battery pack and rack, cables, and battery charger.

1. For engine-generator, sets rated 750 kW and above, a redundant electric starting motor shall be provided.

M. The batteries shall be of the lead acid type. The batteries shall be sized to provide the specified number of starts, cranking time at firing speed (five 10 second cranks) at any ambient between minimum (7 OF) and maximum (105 OF) design ambient temperatures, with final discharge voltage, exceeding minimum control power supply voltage requirements. The batteries shall have a capacity of 135 AH minimum. Batteries shall be complete with cables and rack. Battery shall be rated in accordance with requirements of engine manufacturer. Batteries shall be located for easy removal and servicing.

N. Battery Charger:

1. Current limiting battery charger to automatically charge batteries.
2. Charger shall be dual charge rate with automatic switching to boost rate when required.
3. Charger shall be mounted at rear of engine-generator set inside the enclosure.
4. Control wire connection between starting and safety circuits shall be connected before arriving at job site.
5. The service powered battery charger shall float charge the battery pack and shall be solid0state, full wave bridge rectified type, using silicon controlled rectifiers for power control. The battery charger shall be suitable for the required voltage, and current, battery pack type, shall have a dc output circuit breaker, floating voltage equalization, equalizing timer, a ground detection system, a voltage relay to activate low battery voltage alarms at the engine-generator control panel, and battery charger failure which shall alarm at the engine-generator control panel. Charger shall be 120v single phase.

PART III PUMP

A. Pump shall be designed so all components are accessible with a minimum amount of labor. Both engine and pump shall be warranted and serviced by same manufacturer.

B. Close Coupled centrifugal pump with vacuum priming compressor mounted to a diesel engine.

C. Continuously operated air injector priming device requiring no periodic adjustment or control.

D. Centrifugal pump shall be capable of handling 3” diameter non-compressible solids.

E. Centrifugal pump shall be capable of fully self-priming on its own with a 25’ static suction lift without the need of a foot valve or add-on priming device.

F. Liquid-filled vacuum gauge for system diagnostic shall be viewable from outside enclosure.

G. GR – Ready Prime Series type pump or equal.

PART IV ENGINE STARTING AND CONTROL PANEL

4.01 Furnish and install an automatic starting mechanically controlled engine panel in the pumpengine enclosure (section V.) Starting section shall automatically start engine upon high level sensor through starting contacts in control panel. Unit shall serve to operate as follows: High level sensor contact initiates starting cycle of diesel engine. Lack of oil pressure or over-temperature of cooling system will cause second relay in cranking panel to be energized, causing starting cycle to be terminated immediately. Should engine fail to start for any reason, a time delay relay in cranking panel limits its cranking period to 30 seconds. A push-button switch mounted on cranking panel shall allow engine to be further cranked at the operator's discretion. Resumption of low level shall open engine contacts in control panel and shall cause engine to shut down after 5 minute delay.

4.02 Pump-engine controls will include an auto start feature controlled by one or more float balls or submersible transducer. It shall be a mechanical non mercury type float switch housed in a hermetically sealed polypropylene enclosure designed to extend into a wet well. The transducers polyurethane jacket shielded cable shall be of suitable length for proper installation into a wet well without splicing. The level control system shall

continuously monitor the wet well level. Upon operator selection of automatic operation, the level controller shall start the pump- engine unit when the liquid level in the wet well rises to the pump start level. When the liquid is lowered to the pump stop level the level controller shall stop this pump – engine.

4.03 ENGINE CONTROLS

A. Mechanically controlled engine control panel shall provide the following functions:

1. Battery DC volts
2. Coolant temperature
3. Lube oil pressure
4. Pump-Engine set operating hours
5. With exception to mechanical control is fuel solenoid, starter and shutdown sensors.

B. Automatic/Manual Start-Stop with the following safety shutdowns:

The engine shall be started, stopped, and controlled by a digital controller. The controller shall be weather proof enclosed, and contain an external weatherproof keypad accessible without the need to remove or open any protective cover or enclosure. It shall be designed to start/stop the engine at a signal supplied by high and low level floats or a 4-20 mA transducer. The controller shall provide the following functions without modification, factory recalibration, or change of chips or boards, by simply accessing the keypad.

1. The keypad shall be a capacitive touch sensing system. No mechanical switches will be acceptable. The keypad shall operate in extreme temperatures, with gloves, through ice, snow, mud, grease, etc. and maintain complete weather-tight sealing of the controller.
2. In automatic mode, the unit shall conserve energy and go to “sleep”.
3. The controller shall function interchangeably from float switches, pressure switch, or transducer, as well as manual start/stop by selection at the keypad. No other equipment or hardware changes are required.
4. The controller with integrated Auto Throttle shall be capable of varying the engine speed to maintain a constant level or pressure in a process without a change to the controller other than via the keypad.

5. The start function can be programmed to provide three separate functions each day for seven days (i.e. a start, warm up, exercise cycle on two separate days at different times and for a varying length of time all via the keypad).

C. Manual-Automatic Button:

1. In Manual Mode, manual “Start” button starts engine and runs until “Stop” button is depressed or an emergency shutdown occurs.
2. In Automatic Mode, start/stop sequencing is initiated by either two normally-open narrow angler float switches, pressure switch, level transducer, or a signal from a digital input.
3. The controller shall integrate the engine safety shut-off for low and high oil temperature along with coolant, and provide over-speed protection.
4. The controller shall include standard, field-adjustable parameters for engine cycle crank timer, shutdown time delay, warm-up time delay, and cool-down time delay.
5. The controller shall have only one circuit board with eight built-in relays. Three (3) of the relays shall be programmable to output desired parameter on display and to be used as dry-contacts for communication with JEA SCADA system, all via the keypad without changing relays, chips, printed circuits, or any hardware or software.
6. Standard components shall consist of (24) digital inputs, (7) analog inputs, (1) magnetic pick-up input, (8) 20-amp form “C” relays, (1) RS232 port, (1) RS485 port, (1) RS232/RS485 port, (1) J1939 port, and (1) Full graphic LCD display with backlight.
7. The industrially-hardened Controller shall withstand 10ppm H2S, Vibration of 3 g, 3 axis, frequency swept 10-1000 Hz, in an operating temperature Range of 4° to 176°F (-20° to 80°C) and an operating humidity range of 0-95% Non-Condensing.
8. Controller shall be capable be capable of communicating all status and control via ONE of the following protocols Modbus, Profibus or Profinet.

9. Controller shall have programmable parameters to prevent surges in the system such as ramp time, high discharge pressure warning and shutdown.
10. Over-speed protection and indicator
11. Low lube oil pressure protection and indicator
12. High coolant temperature protection and indicator
13. Over-crank protection and indicator
14. Low coolant level protection

D. Engine Control Switch (Three-Position: Stop – Manual – Auto)

E. Indicator/Display, Test Switch

F. Control device shall be non-alternator driven speed control reframe. Control device shall be read off the magnetic pick-up.

G. Unit shall be capable of interfacing with JEA SCADA equipment

PART V WEATHERPROOF ENCLOSURE, NON-WALK-IN TYPE

A. The complete pump-engine set shall be enclosed in a modular, non-walk-in type, marine
grade aluminum weatherproof enclosure, constructed with 5000 marine grade aluminum. The enclosure shall be constructed of removable side panels and end panels. All fasteners and hardware used in construction of the enclosure shall be type 316 stainless steel. The unit shall have hinged side doors each side and hinged doors at control end, equipped with key locks for ease of engine maintenance, hold open devices and a three point latch system. Doors shall be pad lockable and a minimum of 36 inches. There shall be a stainless steel expanded metal grating or a punched louvered radiator core guard installed - flush with the enclosure panels in front for the radiator grill, and fixed, punched louvered air intake ports on the enclosure sides and rear for proper air circulation within the housing. Provide lifting eyes and spreader bar reinforcement for crane unloading. Provide ¼ inch thick "non skid" deck underneath housing. The enclosure shall be constructed as a sound attenuated style with a maximum dba rating of 85 dba at 15 feet.

B. Battery charger shall be mounted at rear of engine set. Control shall incorporate equipment as previously specified. Control wire connection between starting and

safety circuits shall be pre-connected before arriving at job site. Provisions shall be made for mounting batteries and rack inside the enclosure. The engine control panel, distribution (lights, battery charger jacket water heater, etc.) breaker panel, batteries and accessories shall be enclosed in the enclosure.

C. All engine oil and coolant drains shall be piped to outside of enclosure with shutoff valves and shall have threaded 316 stainless steel with anti-sieze. The threaded drain lines shall be labeled on the outside of the enclosure with an aluminum label with aluminum or stainless rivets.

D. Secondary Enclosure color allowed if requested by special organization or HOA is Padmount Green, Steel-Master 9500 30% Silicone Alkyd Enamel Ultra deep/Clear tint base supplied by Sherwin-Williams or approved equivalent.

E. A minimum of two industrial LED fixtures from Columbia Lighting Model LXEM4-40ML-RFAEDU or equivalent approved by JEA, spring wound timer light switch, prewired distribution circuit, power panel, and duplex receptacles shall be conveniently provided in the enclosure. The light switch and receptacles shall be provided near pump control panel. (For Use on Large Pump Engines. Please note Fixture JEA Standard)

F. Structural wind rating requirement reference 2010 FBCB and ASCE-7-10. JEA requires wind design of 150 miles per hour.

G. Enclosure shall be Phoenix Products, Advanced Manufacturing & Power Systems Inc. or Fidelity Manufacturing.

PART VI EXHAUST AND MUFFLER

A. Each engine-generator unit shall be furnished with complete exhaust system including a stainless steel exhaust silencer, all-stainless steel piping, all-stainless expansion joints and accessories as required for a complete operating system.

B. The exhaust silencer shall be chamber type, of all-welded Type 316 stainless steel construction with all 316 stainless steel hardware and fasteners.

1. The silencer shall be of the side inlet type

2. Secured in position at no less than 4 points

3. The silencer shall be supported by a welded 316 stainless angle iron cradle; silencer shall be bolted or strapped to cradle and then bolted to

the roof support members mounted inside the roof of the enclosure for a horizontal mounting on top of the enclosure.

C. The silencer shall be sized so that the backpressure at rated capacity of the engine does not exceed one-half the supplier's maximum allowable backpressure. The silencer shall be suitable for critical type silencing and shall be a Maxim "Model M51" or equal.

D. All exhaust piping shall be Type 304L, Schedule 10S stainless steel, and the exhaust shall discharge horizontally at the silencer outlet, with 45 degree bevel cut with a stainless expanded metal bird screen.

E. The intake of the silencer shall connect to the flexible exhaust connection by stainless steelpipe. Size as required by engine manufacturer. A flexible stainless steel exhaust adapter, 18 inch minimum length, shall be furnished for mounting between the engine and silencer. The flexible exhaust connection as specified shall mount directly on exhaust manifold and shall be mounted so that no weight is exerted on the manifold at any time.

F. Each engine-generator unit shall be furnished with complete exhaust system including a stainless steel exhaust silencer, all-stainless steel piping, all-stainless expansion joints and accessories as required for a complete operating system.

PART VII FUEL STORAGE TANK

7.01 DOUBLE WALL SUB-BASE TYPE FUEL STORAGE TANK

The tank shall be UL listed, vented, and shall normally be used to store the specific petroleum product at atmospheric pressure. The sub-base fuel storage tank shall have a minimum capacity to provide 72 hours uninterrupted operation of the pump –engine at 100 percent capacity. The sub-base tank shall be of welded steel construction throughout and shall be constructed to permit access to the electrical stub up area. The tank shall have an over fill containment box that will hold 3-15 gallons and have a normally closed, hand operated valve to drain over spill content back into tank. The coating of the tank shall meet the coating specifications in section VII.11. The tank shall be electrically grounded and secured to slab with 4-6 stainless steel anchor bolts w/ stainless steel washers and fasteners.

7.02 UL/ULC LISTING

The tank shall be tested to and listed (and carry UL/ULC labels) for the folloting:

1. UL-142, aboveground tanks for flammable and combustible liquids.
2. UL-2085, two hour furnace fire test and two hour simulated pool fire test for insulated tank.
3. UL-2085, insulated and protected secondary containment aboveground tanks for flammable and combustible liquids.
4. UL-2085 and UFC ECTION (79-7) APPENDIX #A-11-F-1, ballistic and vehicle impact test for protected tank.
5. UL CAN/ORD-C 142.16, protected aboveground tank assemblies for flammable and combustible liquids.
6. UL CAN/ORD-C 142.5, concrete encased aboveground tank assemblies for flammable and combustible liquids.
7. UL CAN/ORD 142.16, the furnace burn requirements for two hour fire rating.
8. UL CAN/ORD 142.5, the open (pool) fire testing for two hour flammable liquid fire test.
9. UL CAN/ORD 142.23, aboveground tanks for waste oil.

7.03 REQUIREMENTS

A. Steel Tank Construction:

1. Steel tank shall be made of 3/16 inch thick steel. The steel tank shall hold the liquid fuel. The tank shall be made in accordance with UL Standard 142 and ULC Standard S601 covering all aspects of tank fabrication including material specification, fabrication, welding and testing. The steel tank's exterior shall be coated with primer paint for protection against corrosion.

2. At the fabrication shop, the tank shall undergo a 24 hour pressure test at 5 psig.

B. Secondary Containment

1. The steel tank shall be wrapped with a minimum of ¼ inch thick Styrofoam (foam) insulation and an imperious barrier of 30 MIL high

density polyethylene membrane (poly). The 30 MIL poly shall provide containment for a fuel leak through the steel tank. A leak detector pipe terminating in the secondary containment shall provide positive-proof that the tank is not leaking.

2. The 30 MIL poly, shall shield and protect the steel tank exterior from coming in direct contact with the concrete and thus minimize the potential of tank external corrosion.

D. Overfill Protection

The tank shall be provided with the following methods to protect against overfill: (a) direct reading level guage at the tank which is visible from fill pipe location, Greenleaf EFG 8000-1 solar gauge with AC back up mounted on exterior of enclosure and 4-20m.A.1 data converter mounted in engine control panel; (b) valve located within fill pipe access to close automatically at a specified fill level.

E. Venting

The tank system shall be furnished with a 2 inch normal vent and an emergency pressure relief system. The standard emergency relief system furnished with the tank shall open if the tank pressure exceeds ½ psi. The tank system shall conform to code requirements and UL/ULC Standards for venting. All vents and fittings utilized on the fuel tank shall be constructed of stainless steel.

F. Support Legs

Vault shall have support legs that provide visual inspection capability.

G. Thermal and Corrosion Protection

The tank construction shall provide thermal insulation to protect against temperature extremes and corrosion by separating the steel tank from the concrete section VII.4.2. No part of the steel tank shall come in direct contact with concrete of any other corrosive material.

H. Spill Containment

The tank system shall include a 5 to 15 gallon, 316 stainless steel spill containment surrounding the fill pipe. The spill container shall be equppied with a normally closed, hand-operated valve that can be actuated to drain the spilled fuel liquids into the steel tank.

I. Bullet Resistance

The tank shall withstand bullet resistance tests in compliance with UFC Section (79-7), Appendix #A-II-F-1.

J. Uplift Restraints

The tank shall be supplied with flood resistant tie-down brackets/hurricane hold-down restraints or bolted down to foundation.

K. Fire Extinguisher and Clean-up Kit

Portable fire extinguishers must be provided for the suppression of fires in accordance with NFPA 10 and UFC for high hazard area. Fire extinguisher and clean-up kit shall be sized and provided by the tank manufacturer. Fire extinguisher shall be of the ABC type and mounted on the interior of the enclosure at the control panel with 316 stainless steel bracket and fasteners. Clean-up kit shall be similarly mounted inside the pump-engine enclosure.

L. Installation

1. Tank shall be installed as per manufacturer's requirements and as per the drawings. Tank shall be installed by qualified personnel who have been approved by the manufacturer and who have knowledge of, and possess the skills and equipment necessary, to install this type of above ground storage tank properly and safely. Do not handle or move the tank unless it is empty. Under no circumstances should a tank containing petroleum product be moved. Do not drop or drag the tank. After install of tank a two part epoxy touch up paint shall be applied to the exposed metal. All mounting hardware shall be 316 stainless steel.

2. Installation, operation and maintenance of the tank shall be carried out in accordance with the applicable codes and regulations. These aboveground storage tanks are intended for installation in accordance with NFPA 30, 30A, 31 and UFC Appendix II-F.

7.04 ELECTRICAL

A. Electrical service and fuel piping to the pumps unit shall be installed in accordance with the requirements of NEC and NFPA and local code requirements.

B. All electrical devices used ith or located within 20 feet of the fuel tank shall conform to NFPA 70 Hazardous Locations. All electric conduits and wiring connected to the tank shall be explosion proof and in strict accordance with NEC Class-1, Division 1 or local standards, whichever is stricter.

C. Electrical grounding is required for flammable liquid fuel tanks Tanks shall be provided with two grounding lugs welded to the nipples on tank top.

7.05 TESTING

A. The tank shall be shipped pre-assembled and shop tested. Upon completion of installation, contractor shall pressure test the primary steel tank to 3 psig. This test shall be performed under the supervision and guidance of the manufacturer's representative and in the presence of the JEA's representative.

7.06 WARRANTY

A. Tank manufacturer shall provide its standard 30 year warranty.

7.07 TESTS

A. Prior to acceptance of the installation, the emergency pump-engine shall be tested at the job site to show it is free of any defects and will start automatically and pump the design capacity of the station. Per the discretion of the JEA representative the contractor shall be required to pump down the wet well of booster station by pass and no-flow situations.

B. Prior to acceptance, any defects which become evident during this test shall be corrected at no additional expense to JEA.

7.08 COATINGS

A. Engine, pump, skid/frame and any ferrous metal surface not to exceed 150 degree Fahrenheit shall be coated per the following specification or JEA approved equal. Surface preparation: Protect all surfaces prom preparation procedures. Solvent clean all surfaces to be coated utilizing Devoe Coatings Devprep 88 Heavy Duty Cleaner per SSPC-SP-1 Cleaning Standard. Abrasive blast per SSPC-SP-6 Commercial Blast as a minimum to all surfaces to be coated. All surfaces shall be clean and dry prior to the applications of all coatings. Any surfaces that are not to be coated shall be protected. Primer Coat: Apply Devoe Coatings Catha-Coat 303H Reinforced Inorganic Zinc Primer

applied at 2.0-4.0 mils dry film thickness. Intermediate Coat: Apply Devoe Coatings Bar-Rust 236 Multi-Purpose Epoxy Coating applied at 2.0-4.0 mils dry film thickness. Finish Coat: Apply Devoe coatings Devthane 379UVA Aliphatic Urethane Glass Enamel applied at 2.0-4.0 mils dry film thickness. All ferrous metal that exceed 150 degree Fahrenheit (exhaust manifold and or muffler pipe) must be coated with hi-heat aluminum. Hi-heat aluminum shall be applied to surface prior to any other coating. Once applied cover to protect the surface and do not allow for overspray of other coatings.

7.09 START-UP

A. On completion of the installation, the initial start-up shall be performed by a factory trained representative of the engine supplier. At the time of start-up, operating instructions and maintenance procedures shall be thoroughly explained to the operating personnel. On turnkey projects the contractor shall be responsible to providing a full tank of fuel for star- up and maintain a full tank till unit/facility is accepted.

END OF SECTION

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